

OF THE
SHERBROOKE GOLD DISTRICT.

TOGETHER WITH A PAPER ON THE

GNEISSES OF NOVA SCOTIA,

AND AN ABSTRACT OF A PAPER ON

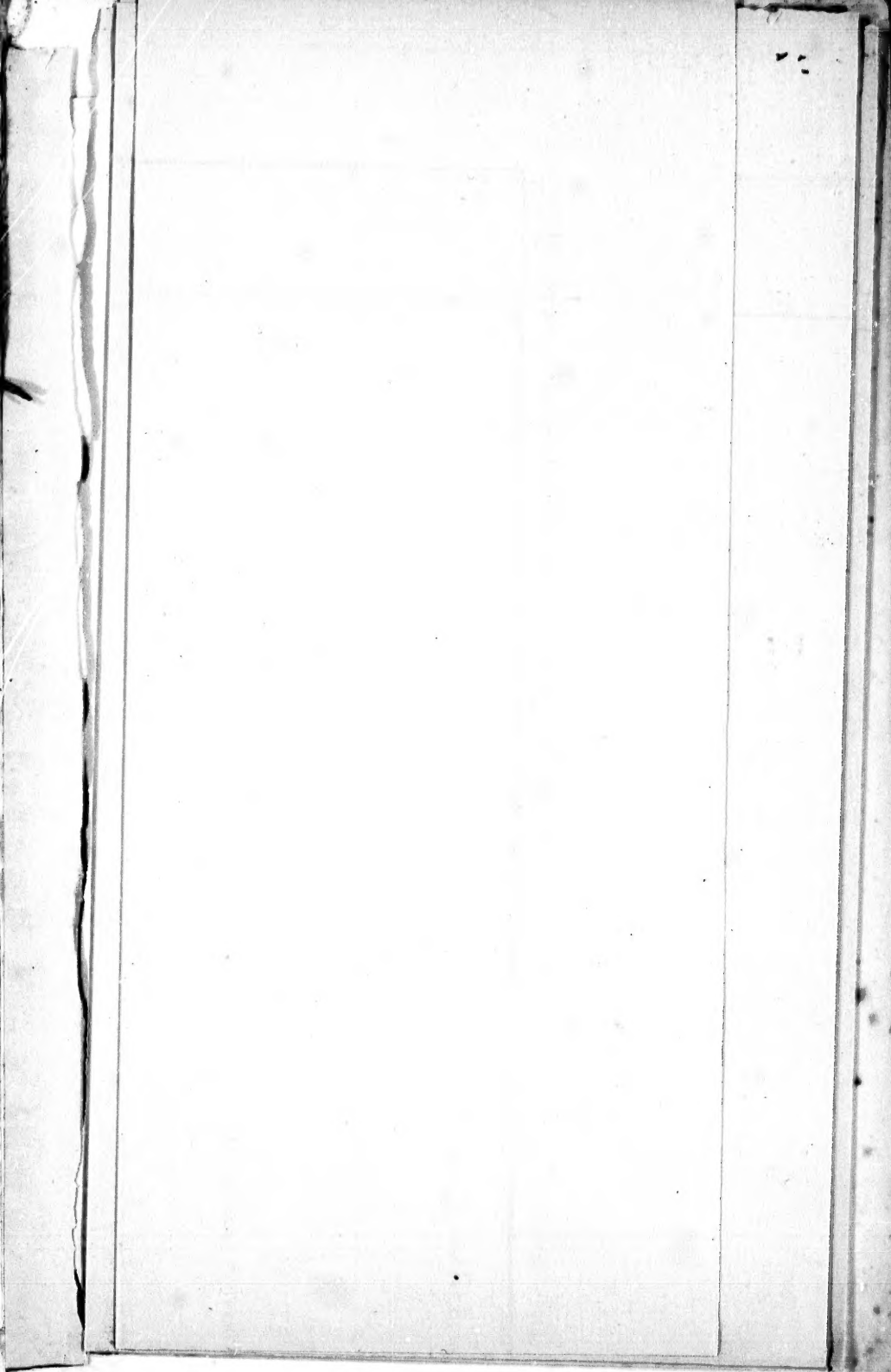
GOLD MINING IN NOVA SCOTIA.

(Read before the Geological Society of London, April, 1870, and the Society of Arts
London, May, 1870.)

By HENRY YOULE HIND, M.A.

HALIFAX, N. S.

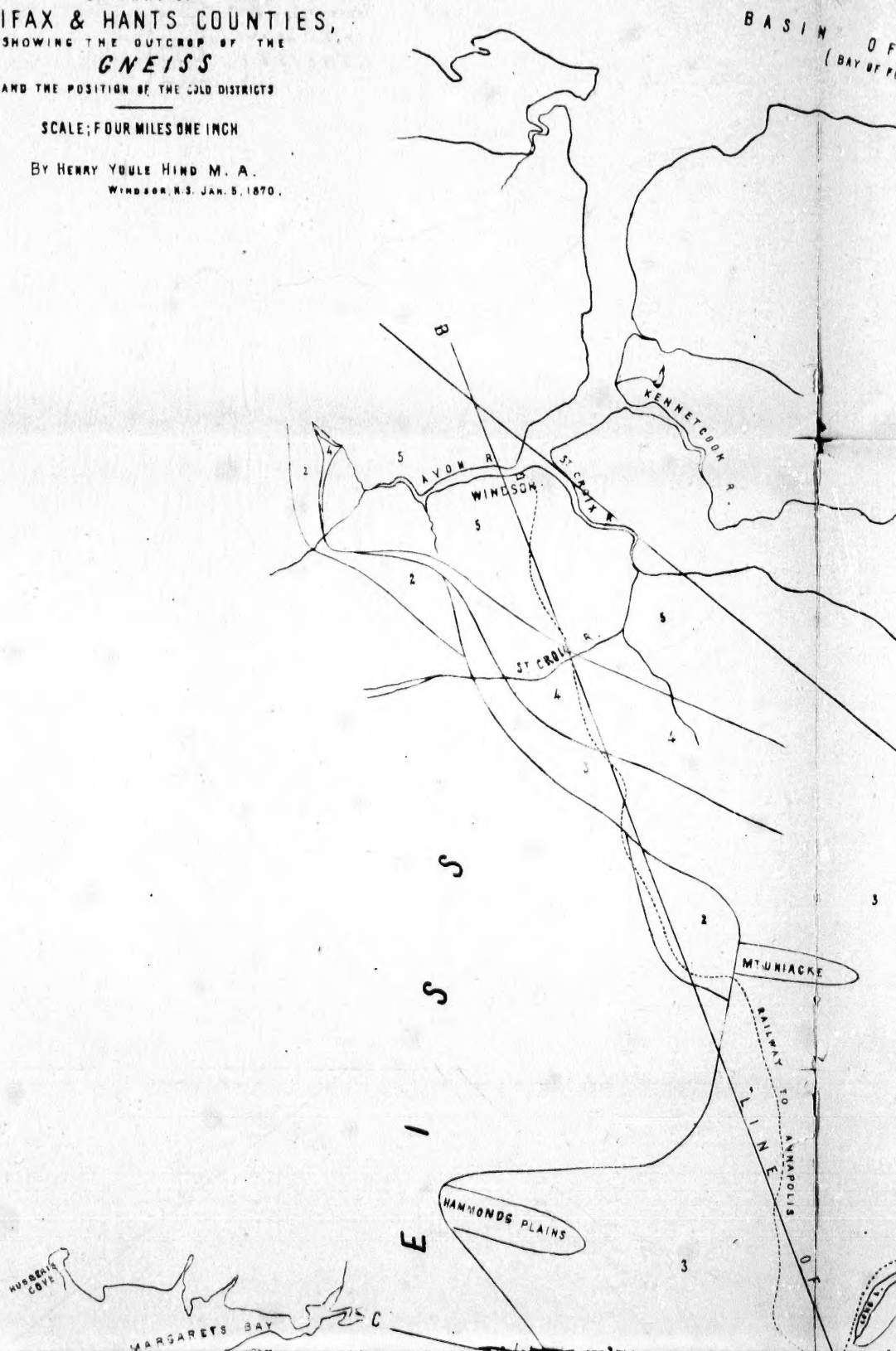
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MAP
OF PART OF
HALIFAX & HANTS COUNTIES,
SHOWING THE OUTCROP OF THE
GNEISS
AND THE POSITION OF THE GOLD DISTRICTS

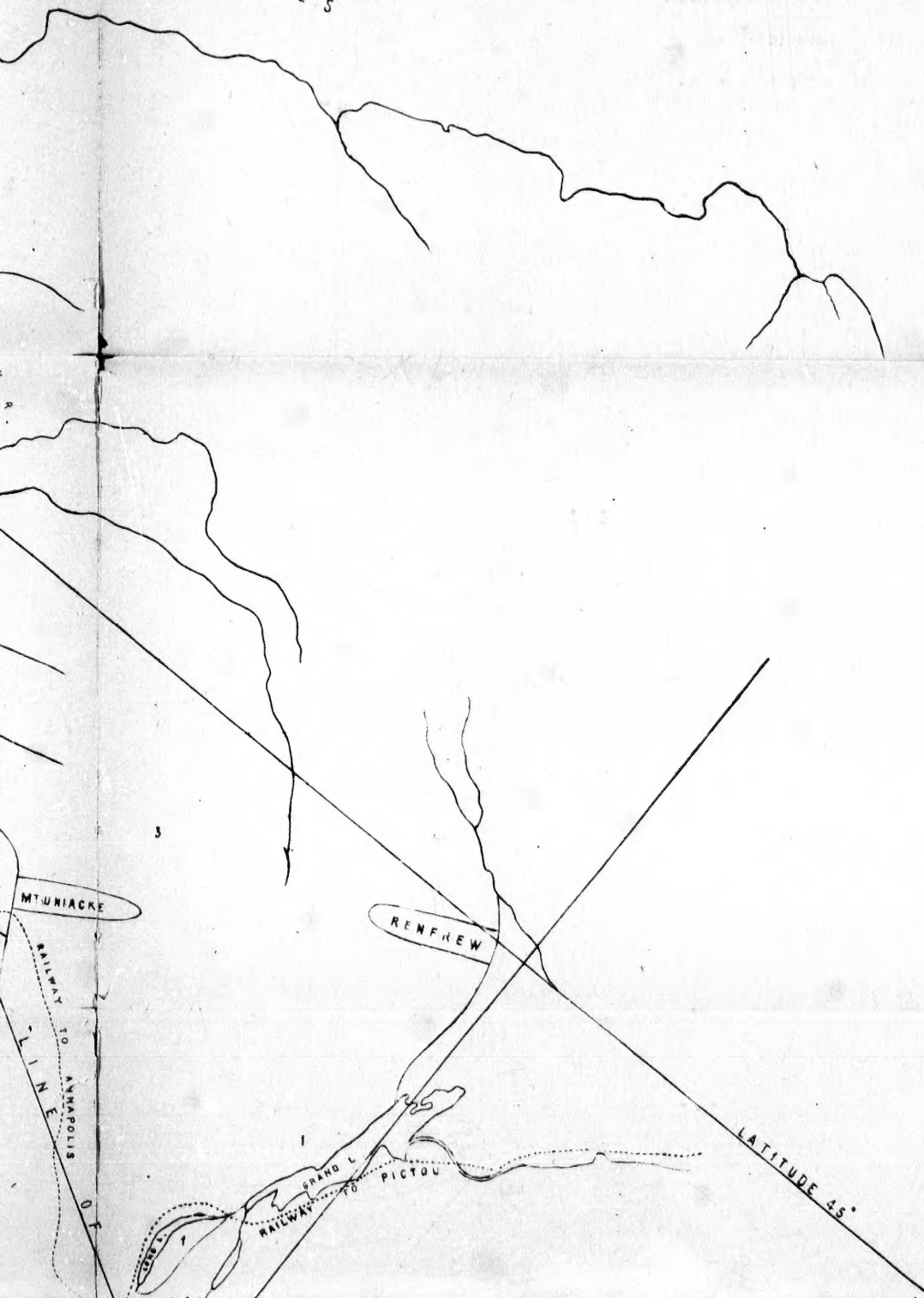
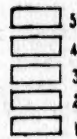
SCALE; FOUR MILES ONE INCH

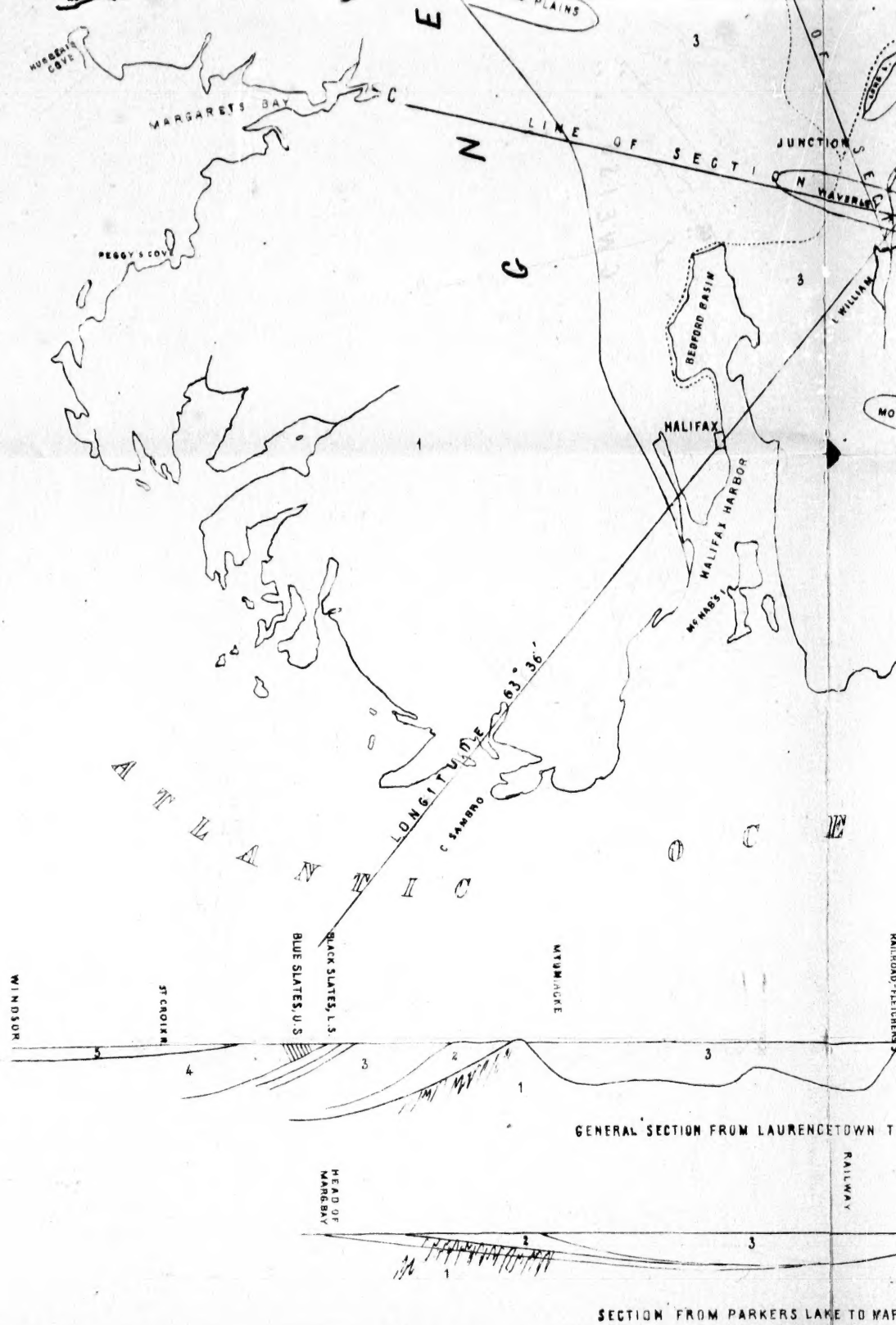
BY HENRY YOUNG HIND M. A.
WINDSOR, N.S. JAN. 5, 1870.

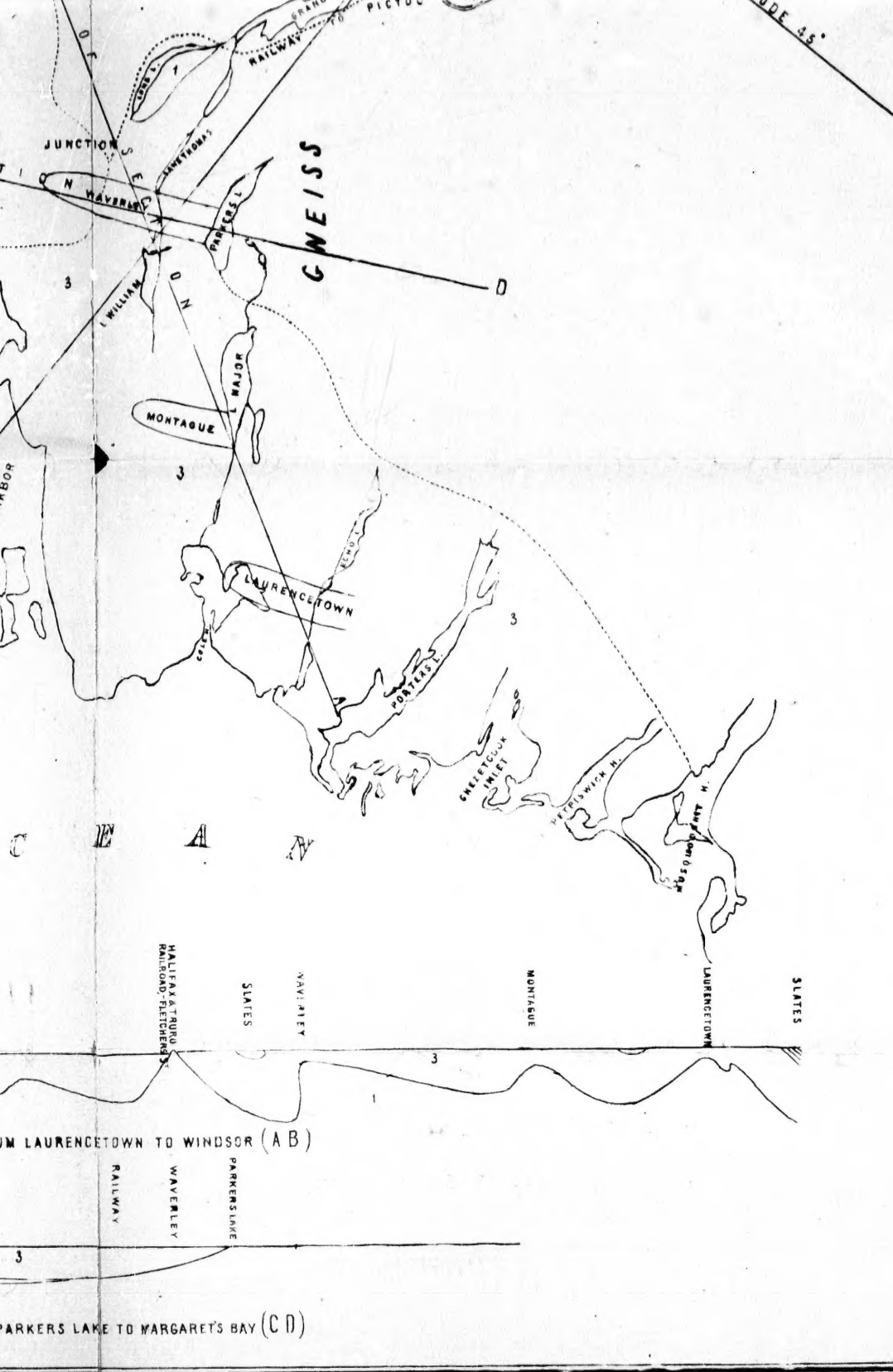


BASIN OF MINES
(DAY OF PUNDY)

CARBONIFEROUS
UPPER SILURIAN
LOWER SILURIAN
GNEISS }







LAURENCETOWN TO WINDSOR (A B)

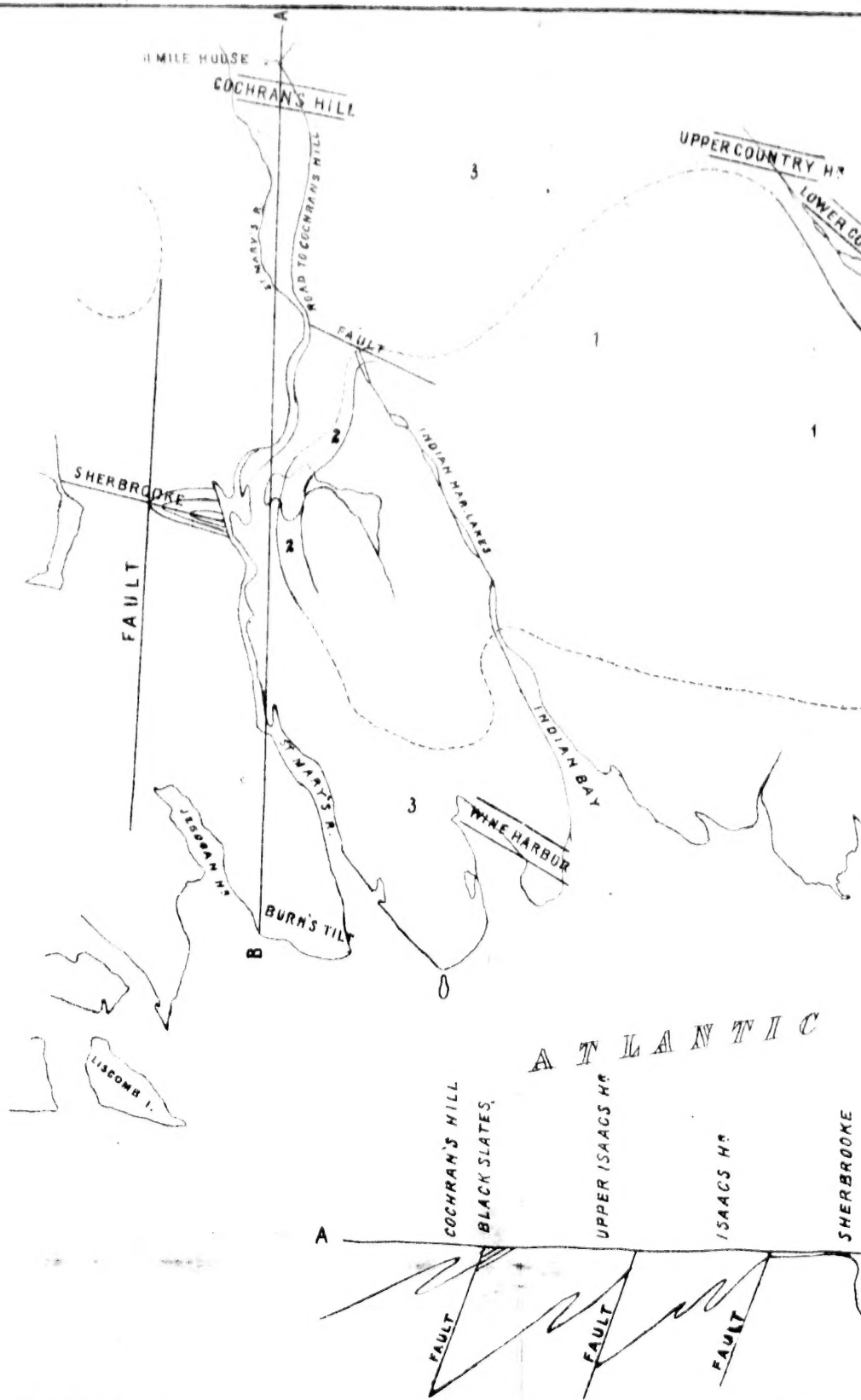
PARKERS LAKE TO MARGARET'S BAY (C D)

SBOROUGH COUNTY

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...GNEISS

SEAL COVE



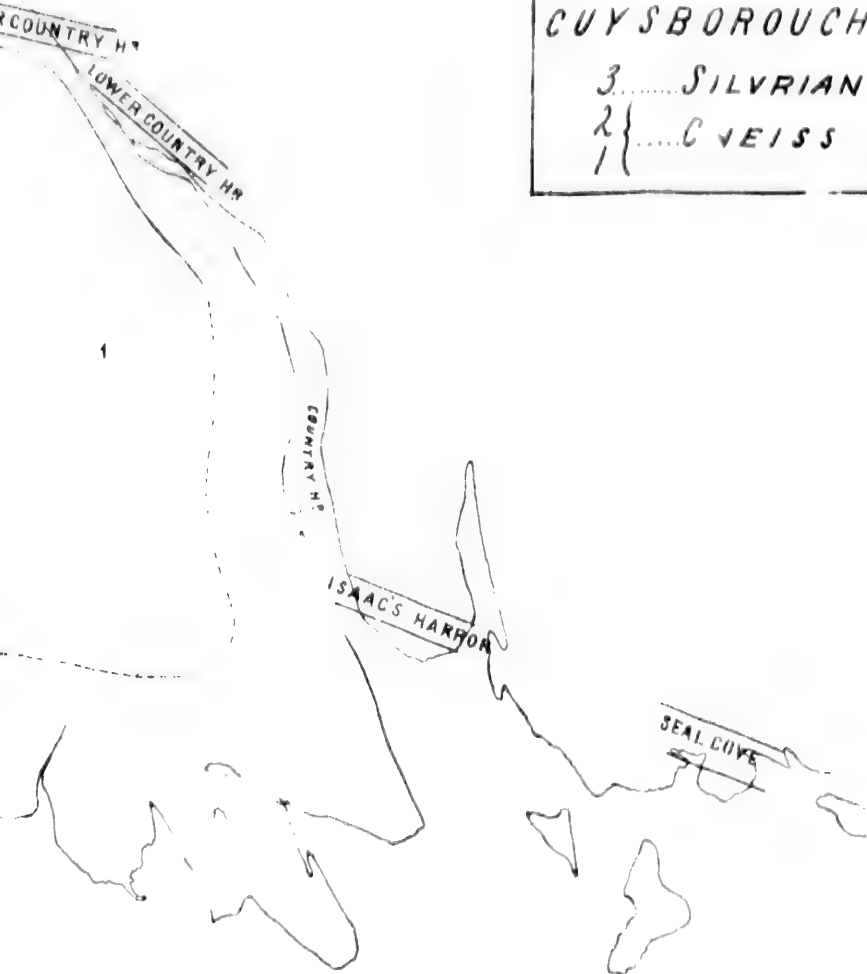
CLARKE'S LITH, HALIFAX, N.S.

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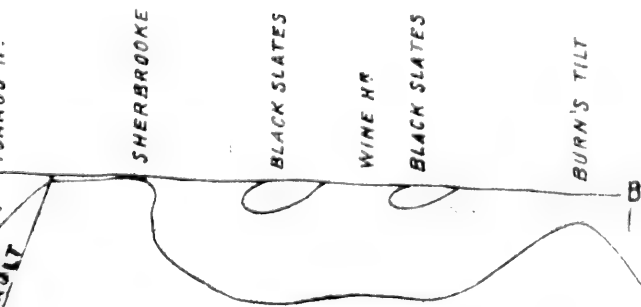
CUYSBOROUGH COUNTY

3.....SILVRIAN

2 }C VEISS
1 }



ATLANTIC OCEAN



SECTION FROM A TO B



REPORT

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ON THE

SHERBROOKE GOLD DISTRICT,

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GNEISSES OF NOVA SCOTIA,

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BIB

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HALIFAX, N. S.

PRINTED BY CHARLES ANNAND.
1870.

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LETTER.

TO THE HON. ROBERT ROBERTSON, M. E. C.

SIR,—

Besides a Report on the Sherbrooke Gold District, the following pages embrace a paper read this spring before the Geological Society of London on the Gneissic Rocks of Nova Scotia, and an abstract of a paper read before the Society of Arts, London, on "Gold Mining and its prospects in Nova Scotia."

1.—SHERBROOKE DISTRICT.

The Report on the Sherbrooke District is necessarily more condensed than it would have been in the absence of the other papers alluded to, with a view to avoid useless repetition.

The importance of the Gold District of Sherbrooke is daily becoming more manifest, and the returns from some of the mines have latterly been very satisfactory, and a few of the enterprises there, which were not based upon a substantial financial footing, have given place to, or are in process of being represented by others of a more practical character.

For obvious reasons I have carefully avoided referring to the names of different proprietors, but with a view of fairly representing the amount of gold obtained from different areas, a comprehensive table at the close of the Report, furnished by the Mines Department, gives the gold product from time to time of certain parcels of quartz, the quantity of quartz crushed, the areas from which the quartz was taken, and the leases in which those areas are now included.

2.—THE GOLD-BEARING LODES.

I have adverted at some length to the different kinds of gold-bearing lodes which are more or less worked in the several Districts in the Province. These are described as the bedded lodes, the intercalated lodes, the gash lodes and the

true veins. The bedded and intercalated lodes being those which lie parallel with the stratification, the gash and true veins cutting the strata at various angles.

Recent experience shows that too little attention has been devoted to the true veins, which are generally of later age than the bedded lodes. During the present year small, but remarkably rich true veins have been worked at Montague and Oldham, and formerly, at Mount Uniacke, a small true vein yielded valuable results. At Tangier the true veins, locally called "bull veins" have been entirely neglected, and during a recent examination of one of the mining properties at Tangier, the presence of a "bull vein" near a bedded lode was represented to be very prejudicial, and "to make the bedded lode poor," where it cuts the bedded lode or closely approaches it. As long ago as 1864, Professor Silliman noticed this in a report on the then "New York and Nova Scotia Gold Mining Company." In speaking of the "Middle lode" he says "it is associated with what is locally called a 'bull lode,' or cross course, two or three feet thick, intersecting the place of stratification, and therefore a true vein. Lodes of this description in Nova Scotia are usually barren of gold. Hence a prejudice arose against this Middle lode, which shows but little sulphurets, and the quartz of which is of a compact, somewhat oily character." A "bull lode," or fissure vein, approaches, touches, but apparently does not cut the well known and rich Leary lode at Tangier, and the crushings show that the Leary lode near the "bull vein" is much less rich than some few yards from the point of contact. Doubtless there has been a transference of minerals, gold included, from the older bedded lode to the newer "bull vein," and as this vein is many inches in thickness, although it may be poor compared with the Leary lode itself, it is a store in reserve which will one day become available when crushing can be profitably accomplished, with quartz yielding 4 or 5 dwts a ton; which, with veins from 16 inches to two feet in thickness can be done with water power. Attention should be directed to these "bull veins," in consequence of their frequent occurrence in some districts, and the prejudice which attaches to them. They may yet be found to be well worth careful crushing, and in connection with the more frequent working of very rich,

but small true veins, they reveal a source of gold wealth hitherto comparatively neglected in the Province.

3.—LOW GRADE QUARTZ OR MINERAL.

It is a popular impression in Nova Scotia that large lodes, whether bedded or occurring as true veins, and showing a thickness of two, three and even four feet of white quartz are barren, although I am not aware that any attempts on a large scale, say the crushing of ten to twenty tons of such quartz, with the subsequent analysis of the tailings to discover the loss, has ever been attempted in Nova Scotia. I have frequently urged the importance of a fair trial of some of these large lodes, in which analysis shows the existence of gold, but without success. The impression appears to prevail that unless gold can be seen by the unassisted eye in a lode it is useless to crush it, and it is stigmatized as barren. These large lodes are common at Mount Uniacke, Sherbrooke, and especially at Mooseland. If they yield but 4 dwts to the ton and preserve a thickness of three feet, which they often show at the surface for many hundred yards, they can be profitably worked by water power and economical manipulation.

4.—SLATE BANDS.

There is, however, another highly important source of gold which has not yet received due attention in any mining district in the Province. In several districts, among which Sherbrooke, Wine Harbor, Tangier, Mooseland, and Ecum Secum, may be mentioned, there have been found belts of slate interseamed with numerous small and probably intercalated gold-bearing lodes; the whole mass of slate and quartz yielding from four to seven pennyweights of gold per ton.

On page 30 of this report, attention is drawn to the extraordinary low average yield of some mines in Victoria, which are worked with a profit. From 2 dwts. 2.38 grs. to 5 dwts. 9.01 grains per ton are recorded as the returns of more than one million tons of quartz crushed in Victoria. The conditions are, an unlimited supply of ore cheaply obtained, and cheap crushing.

I have been informed on the best authority that the cost of crushing mineral (drift on the bed rock, &c.) has been accom-

plished in Nova Scotia, by means of water-power, at a cost of from 35 cents to 40 cents a ton, including interest on the capital sunk in the construction of the mill. Large belts of slate holding small and intermittent lodes, common throughout Nova Scotia, can be mined and conveyed to the mill for from \$1 to \$1.50 a ton in some districts, when favorably situated. By water-power this mineral can be crushed at a maximum cost of 50 cents a ton; hence the total cost will be \$2 a ton. Any excess of gold over 2 dwts. and 3 grains per ton will be added to the profit side of the account; and here we may approach the successful mining operations pursued at Ballarat, Sandhurst, &c., in Victoria.

Water-power is an essential requisite, for, with the utmost economy, it is barely possible to crush with steam-power at a less rate than \$1.25 per ton. Hence, I think we are justified in entertaining the opinion that the cheap crushing of low grade quartz will soon attract the attention it merits in Nova Scotia.

In one district I have recently had the opportunity of examining, the enterprising proprietors of a large mining property, which embraces numerous belts of auriferous slate with small lodes, are now constructing a water-power mill capable of driving from forty to fifty stamps. They propose to direct especial attention to the slate belts, and to adopt the principle of crushing cheaply mined, low grade mineral, with the utmost economy.

The multiplication of enterprises of this character will rapidly change the general features of Nova Scotia gold mining.

5.—ANALYSIS OF TAILINGS.

The systematic analysis of tailings is very generally neglected throughout the Province. Without this guide it is impossible to know the amount of daily loss in the manipulation of the quartz. The concentration of the tailings by means of Buddles, Blanket Strakes, &c., is still unknown, although about to be adopted in one instance, and the use of long sluices and sluice boxes to save floured mercury is not practised.

The analysis of the tailings would not only afford a fair idea of their value, but the greater or less daily loss would lead to the adoption of changes in the mode of manipulation which

would result in the saving of a considerable quantity of gold. The alterations which suggest themselves in some instances are a change in the size of the screen meshes, the prevention of the splash in the stamp boxes, a diminution or increase in the quantity of mercury introduced into the stamping boxes, a less or greater inclination in the copper plates, and where arsenical ores prevail the adoption of proper artifices to keep the plates clean.

Attempts have frequently been made to roast the pyrites, and highly pyritous ores previously to crushing, the object being to drive off the arsenic and sulphur. This has been attempted in some instances in kilns, in others in open air. In both cases failure is a necessary consequence of the mode of attaining the object in view. The heat and access of heated air in a kiln, and still less in an exposed heap, is wholly insufficient to drive off the arsenic and sulphur. A part only is driven off, and the condensation of a portion on the cooler exterior of the mass of ore does more harm than good by coating the gold and preventing its amalgamation. A reverberatory furnace is alone capable of completing the operation in a thorough manner. In the works of Brough Smyth, Phillips, and more especially of Kustel, descriptions of these furnaces are given.

At some of the mining establishments at Sherbrooke, where successful operations are now being carried on, the employment of a few of the artifices alluded to, especially where water power is available, will enable them to manipulate low grade quartz profitably, which has hitherto been considered worthless, and thus largely extend their sphere of successful operations.

6.—ALLUVIAL GOLD.

Alluvial gold mining has not been carried on in Nova Scotia in any degree commensurate with the value of the auriferous deposits which are in a greater or less degree known to exist, and which in all probability occur to a much larger extent than is generally supposed.

An impression has arisen that the gold districts of Nova Scotia as well as the greater portion of the Province, present nothing but rocky denuded areas, without any or at least very small drift deposits. The contrary is indeed the case in

some districts, and numerous wide spread surfaces exist where alluvial gold mining cannot fail to be pursued with great profit if sufficient capital is embarked in the enterprise.

Drift deposits are found at Waverley, upwards of fifty feet deep, and at Tangier, similar deposits exist which have already yielded remarkable returns and have been abandoned on account of want of means to cope with the influx of water.

A moment's reflection will satisfy the most incredulous, that where rich gold-bearing lodes are exposed near the surface, in the valleys adjacent to such exposures or in crevices in the rocky surfaces, the gold from the denuded lodes must have accumulated by its gravity. When, however, the lodes occur at the summit of a hill or on its slope, in the valley below, whether occupied by a lake, swamp, or by drift, much of the liberated gold will be found on the bed rock and in the crevices, or in the lowest stratum of drift. It has been alleged that the greater part of the former auriferous drift of Nova Scotia has been carried by glacial action into the Atlantic, and now forms the submarine banks of the coast. Any one familiar with the laws which govern the distribution of gold in sand and drift gravels know well, that unless intercepted by a bed of clay, gold, however fine, will always filter through sand, and the allegation that sand *per se* is auriferous anywhere must be received with due caution. Some retentive substratum must exist to arrest the downward progress of the gold. Nowhere do we meet with a more striking illustration of the wonderful facility with which gold seeks the lowest level than in the tailings of our crushing mills. It is useless to search the sands of the tailings for gold. The metal may be found, and is largely found in the cemented masses of sand whose particles are agglutinated by oxide of iron, and thus arrest the downward progress of the gold; but in pure sand, gold, however fine, is always moving downwards, impelled by its great specific gravity, which is from seven to seven and a half times that of the sand. Rains, variations of the atmosphere, and vibrations, all accelerate the downward progress of gold, and in examining tailings, apart from the cemented masses, we must look at the bottom of the heap. So also in natural gravels, they must be examined at or near the bed-rock; if they contain a notable per centage of clay

some gold will be arrested, but in all cases the bottom of the deposit will contain nearly all the gold, if the gravels or sands are of an incoherent nature: hence, it follows that lake bottoms lying at the base of hills where auriferous lodes occur will be found rich in the metal. Precisely this condition of things occurs at Tangier. Copper Lake and Rush Lake lie at the base of the hill where many gold bearing leads are exposed, and on the bed rock and especially in the crevices of the surface and some feet downwards, gold to an extent, probably wholly unexpected, will, during ages of denudation, have accumulated.

Already attempts have been made to drain Copper Lake, but the drainage channel carried off only the visible water of the lake, so that as soon as shafts were sunk in the former bottom, water soon arrested progress in the absence of proper pumping machinery.

It is now proposed to drain Copper Lake effectually by means of an adit level on the course of the Field lode. Already upwards of 400 feet have been excavated at a depth considerably below the level of the lake as far as known. There remains but a distance of 200 feet to tunnel, and in all probability the greater portion, if not the whole of Copper Lake, will be easily and successfully mined for alluvial gold. Rush Lake, on the other hand, is about 23 feet above the sea level. It is proposed to excavate an open trench from the sea-shore to Rush Lake. The distance does not exceed 1850 feet, and the streamlet would afford the water supply of the sluices. Not only is the whole of Rush Lake a very promising field of "Pay dirt," but also the valley through which the streamlet flowing from it, finds its way to the sea. Care must be taken to wash only the lowest stratum of gravel and to excavate the channel in the bed-rock if possible, washing the whole of the excavated rocky portion.

Numerous quartz boulders will be found in the drift; these should be reserved for the mill. So large indeed is the number of these boulders, most of those visible showing gold, that the works for draining Rush Lake, and sluicing the "Pay dirt," will very probably be paid for out of the yield of the quartz boulders alone.

In order that operations for winning the alluvial gold in

Copper and Rush Lakes may be entirely successful, the work must be thoroughly done. The lowest attainable level should be preserved, and only the lowest stratum of gravel passed through the sluice, without the excavations reveal, which is not probable, a retentive bed of clay in the drift. The large boulders need not be touched, unless they rest on bed rock it is desirable should be sluiced.

The area where alluvial gold will be found in richly paying quantities is not confined in this district to Copper and Rush Lakes, a considerable portion of the valley leading into Pope's Harbour lies under gold-bearing lodes, which occupy the neighbouring hill and pass through this denuded valley itself. It is here that attempts were made some years since to win alluvial gold, many nuggets were found and a considerable quantity of fine and coarse gold, but here as elsewhere, water arrested the progress of the enterprise, which was not carried on with adequate means or appliances.

I have adverted at some length to this subject, because there appears to be no doubt that there are many localities in Nova Scotia where all the conditions are favourable for alluvial mining, and it is advisable that attention be directed to this important source of gold.

7.—ANCIENT AURIFEROUS DRIFTS.

In the paper read before the Society of Arts, I adverted very briefly to the occurrence of auriferous drift at the base of the Lower Carboniferous Conglomerate on Gay's River. Where the Carboniferous Conglomerates are seen to rest on the gold-bearing rocks, it is reasonable to suppose that much of the material of which they are composed will have been derived from the wearing away of the underlying gold-bearing strata, and here we may anticipate the occurrence of auriferous drift, especially in ancient river valleys. These conditions appear to be fulfilled in the lower portion of the valley of the St. Croix, and some of its tributaries, also in the vicinity of the Renfrew gold district and elsewhere. The ancient river valleys are by no means necessarily coincident with existing valleys, but may be many hundred yards removed from them and far more profound, or on the adjacent hill-sides. It is clear, however, that when such an ancient river valley is once

discovered and found to hold auriferous drift, an immense field would present itself for enterprise. In Australia the ancient river valleys which have proved so productive are frequently discovered several hundred feet below the existing surface and sometimes the gravels they contain are deeply covered with basaltic rocks. In Brough Smyth's work many instructive sections are shown which may be studied with advantage in connection with the auriferous lower carboniferous conglomerates of Nova Scotia.

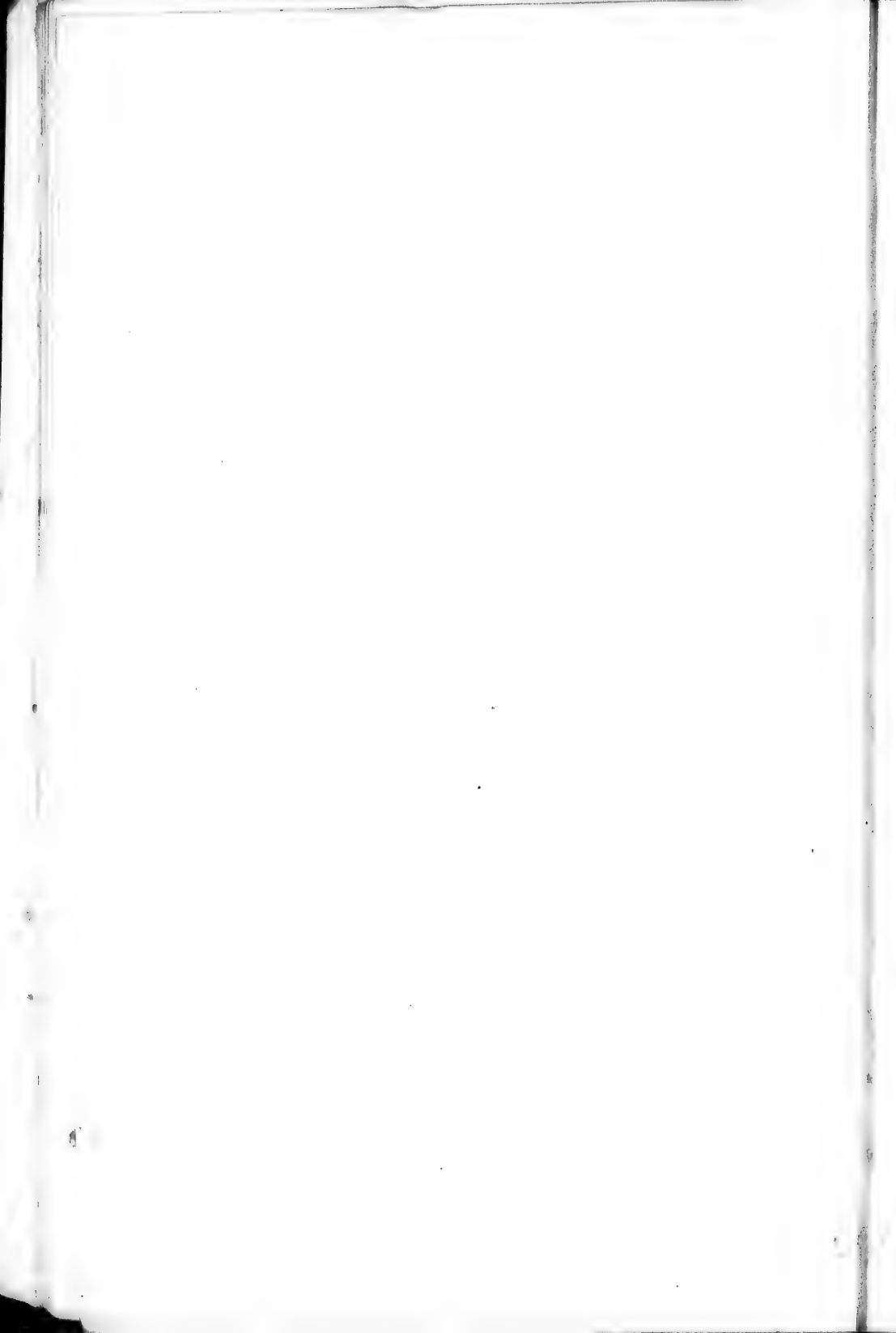
The supposition embodied in the foot note on page 8, that a synclinal fold exists in the black slates west of Ellerhouse Station, appears from recent examination to be very probable. This structure would involve the recurrence of the gold-bearing series between Ellerhouse and Newport Station, and the argillites there seen would represent the less altered portions of that series, which would sweep in the form of a very narrow belt round the carboniferous basin of the Avon River towards the Falmouth Mountains. It is with reference to this probable extension of the gold-bearing rocks, that the conglomerate at the base of the lower carboniferous series acquires a similar interest to the auriferous conglomerate on Gay's River.

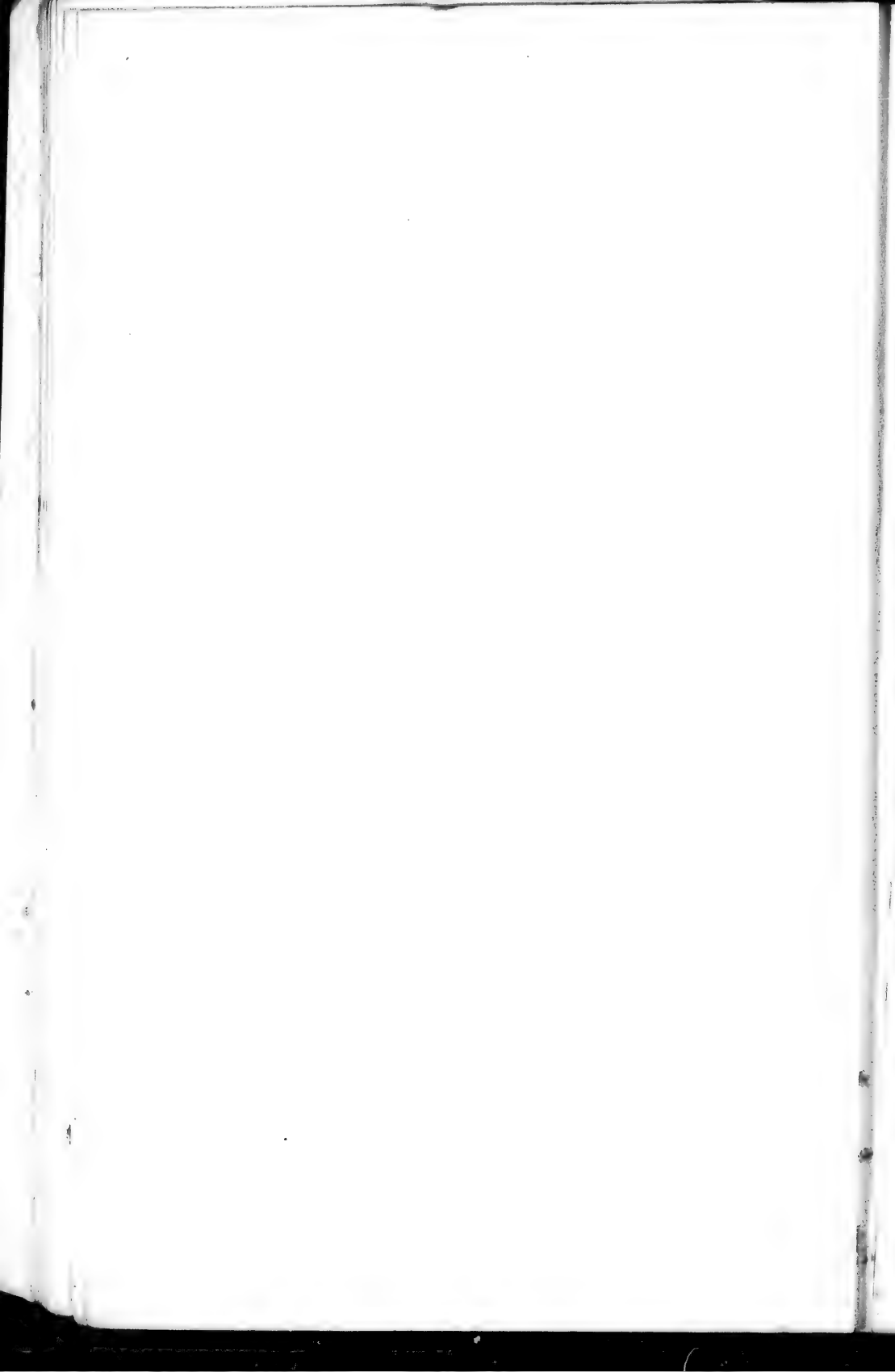
I have the honor to be,

Your obedient servant,

HENRY Y. HIND.

WINDSOR, June, 1870.





INTRODUCTION.

Throughout the length of Nova Scotia, from the Gut of Canso to the Tusket Islands, there exists an interrupted axis of Granitic rocks, which have hitherto been regarded as almost altogether composed of eruptive granite. The aspect of these rocks at the first glance tends strongly to support this view, and even a more minute examination of their relations to the gold-bearing quartzites which abut on them, appears to offer additional proof of their igneous and intrusive origin.

At the junction of the visibly stratified quartzites, supposed to be of Lower Silurian age, granitic veins are frequently seen to ramify throughout a few feet of the quartzites, and masses of a schist, resembling in some particulars the altered quartzites and slates near the granitic rocks are wholly imbedded in the granite. Hence, any one relying upon the evidences which a cursory examination is capable of affording in many places where the junction of the two rocks is visible, would be disposed to assert with confidence that the granite was an intrusive rock, and that there had been an outburst of this molten material from one end of Nova Scotia to the other. If, however, the relations of the granitic rocks and the quartzites be examined in several different localities remote from one another, the conclusion is irresistible that the granite is a sedimentary deposit, and consists of two deposits resting unconformably upon one another. This is especially to be noticed about half a mile in the rear of Sherbrooke village, on Lynch's Mountain, where the gold-bearing rocks are seen to rest on bedded gneiss holding boulders of a schist, which is visible in beds with gneiss (granite) above and gneiss (granite) below, near Mount Uniacke.

But the most remarkable proofs of the aqueous origin of the granite rocks and consequently of their stratified character are the boulders and pebbles they contain. These, except on freshly exposed surfaces, are rarely visible without careful

search, elsewhere than in railway cuttings and quarries. The granites almost always hold water-worn pebbles and boulders, and this not near the junction with quartzites only, but remote from these rocks.

Again, these pebbles are symmetrically arranged, showing the dip of the gneiss. They are often smooth and rounded; and sometimes also masses of schist, which do not present rounded edges, occur in the granite. Viewed on a large scale, the granite is seen to be arranged in the form of thick beds whose strike is the same as the pebbles.

The granite, or rather gneisses, break through the gold-bearing series in many places, but they are brought up by faults—and four miles from Sherbrooke this form of contact can be seen without the slightest alteration in the adjacent quartzites. In other places, as on the line of the Halifax and Windsor railroad, the gneisses appear to have in a plastic slate where the uplift took place, for veins are found squeezed into the cracks and interstices of the thin bedded gold-bearing rocks, and it is this aspect which leads at the first blush to the impression that the "granite" is an intrusive rock, and not a lower series brought up by a fault, an illusion which careful examination at Sherbrooke and other parts of Nova Scotia serves to dispel.

In speaking of the granites in Victoria, Mr. Brough Smyth makes the following remarks:—"As connected with the theories of this writer (Thomas Belt, Esq.) it is not out of place to refer to the opinion of the Government Geologist, who says that 'granites are in no sense intrusive or irruptive masses, but only the completely transmuted ends of the Silurian rocks, which have either been lowered in early geological times to within the influence of central heat, or by some means have been subjected to other powerful transmuting agencies.'* In Nova Scotia, the granites belong to a lower sedimentary series than the gold-bearing rocks which are supposed to be of Silurian age, since these deposits rests unconformably upon them.

* Gold Fields of Victoria.

THE GNEISSES OF NOVA SCOTIA UNDERLYING THE GOLD-BEARING ROCKS*

The descriptions contained in this paper, so far as they relate to Nova Scotia, are in the main the results of observations during the summers of 1868 and 1869, while making Geological surveys for the Nova Scotia Government, on the gold districts of Waverly and Sherbrooke. The comparisons with New Brunswick are based on my official Report in the

* [From the Abstracts of the Proceedings of the Geological Society of London.]

"On the two Gneissoid series in Nova Scotia and New Brunswick, supposed to be the equivalents of the Huronian (Cambrian) and Laurentian." By H. Youle Hind, Esq., M. A. Communicated by Professor Ramsay, F. R. S., F. G. S.

This paper described the relations of two gneissoid series in Nova Scotia and New Brunswick, which have hitherto been regarded as intrusive granites and syenites, and have been thus represented on the published geological maps of those provinces. The author considered that these gneisses were in the main of Laurentian age, the Huronian or Cambrian rocks occurring only in patches over a vast area of Laurentian porphyroid gneiss.

The old gneiss was stated to be brought to the surface by three great undulations between the Atlantic coast of Nova Scotia and the Laurentian axis of America north of St. Lawrence. These axes were rudely parallel to one another, and in the troughs which lay between them the Silurian, Devonian and Carboniferous series occurred in regular sequence, the New Brunswick Coal-field occupying the central trough. On the line of section, in troughs to the north-west and south-east, the Lower Carboniferous was stated to be the highest rock series which has escaped denudation.

The gold-bearing rocks of Nova Scotia are of Lower Silurian age, and rest either on Huronian strata or, where these have been removed by denudation, on the old Laurentian gneiss. The gold is found chiefly in beds of auriferous quartz of contemporaneous age with the slates and quartzites composing the mass of the series, which, in Nova Scotia, is 12,000 feet thick; and the auriferous beds are worked, in one district or another, through a vertical space of 6000 feet. Besides auriferous beds of quartz, intercalated beds and true veins are found to yield gold, and are worked.

A series of sharp and well defined anticlinal ridges the province of Nova Scotia from east to west, while another series of low broad anticlinals of much later date have a meridional course. At the intersection of these anticlinals the gold districts are situated, because their denudation has best exposed the upturned edges of the auriferous beds of quartz, and rendered them accessible, sometimes exposing the underlying gneiss. Plans of Waverly and Sherbrooke gold districts were exhibited showing the outcrop of the edges of the slates and auriferous beds of quartz in semi-elliptical forms, with gneiss at the base of the ellipse. On this ground it was suggested that a correct mapping of the gneisses of Nova Scotia would have an important influence on the development of the mineral resources of the province.

A plan of some of the lodes in the Waverly gold district showed the result of operations in 1869, subsequently to the publication of a geological map and sections of the district furnished to the department of Mines by the author in 1868. Citations were made from the annual reports just issued by the Chief Commissioner of Mines and of the Inspector of Mines, confirming the correctness of the author's plans exhibiting the geological structure of Waverly, which is a type of all the Nova Scotian districts.

DISCUSSION.—Principal Dawson spoke in confirmation of the fact that the Palaeozoic rocks are underlain by Laurentian gneiss, &c., quite to the eastern coast of British North America, and stated that the same relation occurred in Newfoundland, and had been traced southward into Massachusetts. He confirmed Mr. Hind's views generally, and stated that the Lower Silurian of Nova Scotia includes no great fossiliferous limestone like that of the interior of North America. The supposed *Eozoön* discovered by Dr. Honeyman, was probably distinct from *E. canadense*, but was certainly a Foraminiferal organism allied to *Eozoön*; but as *Eozoön bohemicum* is of later date than *E. canadense*, the presence of *Eozoön* did not necessarily indicate Laurentian age.

Professor Ramsay suggests that other organism besides *Eozoön* aided in building

geology of that Province; * and the references to Cape Breton, when not otherwise stated, are from MS. notes of explorations in that Island in 1866.

The object of this paper is to show that two gneissoid series supposed to be the equivalents of the Huronian and Laurentian of Sir W. E. Logan, are exposed over very large areas in Nova Scotia, the Island of Cape Breton, and in New Brunswick. The boundaries of the series have been traced through parts of Halifax, Hants, and Guysborough counties, in Nova Scotia. In New Brunswick, ‡ numerous narrow belts extending from the Bay of Chaleur to the boundary line between New Brunswick and Maine, are supposed to represent these Gneisses, and are described in my Report on New Brunswick, published in 1865, (pp. 42-52.)

Geological maps of Nova Scotia were published by Dr. Abraham Gesner, in 1836, ‡ by Dr. Dawson, 1865, § and 1868, § and by Sir William E. Logan, in 1865, ¶ and 1869. **

Sir William Logan states, in his introduction to his Atlas of Maps and Sections, that for the Geology of Nova Scotia, "a manuscript map by Dr. J. W. Dawson, compiled from his own resources and those of Messrs. B. Brown and H. Poole, has been the source of information." Hence, in making the necessary comparisons between the subjects of this paper, and the published descriptions and maps of Nova Scotia, I shall have to refer almost exclusively to Dr. Dawson's map of 1868, accompanying the 2nd edition of his beautiful work on Acadian Geology.

up these great calcareous masses. He inquired as to the mode of occurrence of gold, and suggested that the gold is obtained at the anticlinals merely because the exposure is better, and that it will be found to pervade the synclinals also.

Mr. Henry Robinson had visited the Waverly district in company with Prof. Hind, in the winter of 1868, at which time the mining on the lodes referred to in the map before the Society was at a standstill, the lodes having been lost by reason of a fault. He thought it very satisfactory to find that the explorations of Professor Hind, and the theoretical position which he assigned to the lodes, had been completely verified. Mr. Robinson also stated that gold is being mined in the synclinals by sinking shafts and driving cross-cuts.

Mr. Hind remarked that all the Lower Silurian in Nova Scotia was auriferous, and that the gold was derived from the underlying Laurentian rocks. He stated that Sir W. E. Logan had indicated an auriferous zone in the Laurentian of Canada. Gold was finely distributed in the slates of Nova Scotia, as in Victoria, in the neighborhood of lodes, according to Mr. Brough Smyth.

* Preliminary Report on the Geology of New Brunswick. Fredericton, 1865.

† In Southern New Brunswick, Prof. Bailey and Mr. Matthew have discovered, and described rocks of Laurentian and Huronian age.—"Observations on the Geology of Southern New Brunswick." Fredericton, 1865. Also, see an able paper by Mr. Matthew in the Journal of the Geological Society of London, for 1865.

‡ Remarks on the Geology and Mineralogy of Nova Scotia by Abraham Gesner, Halifax, 1836.

§ Acadian Geology. 1st Edition.

§ Acadian Geology, 2nd Edition. MacMillan & Co., London, 1868.

¶ Atlas of Maps and Sections. Montreal; Dawson Brothers, 1865.

** Geological Maps of Canada and the adjacent regions; 1869. London, Edward Stanford.

In a preliminary Report* on the supposed Laurentian of Nova Scotia, I have quoted some passages from Dr. Dawson's work, especially the explanation to the Geological map, in which the uncertainty of the boundaries of formations, and the doubtful age of some of the strata, is adverted to. The recognition of a very large gneissoid area in Nova Scotia, supposed to represent two series not hitherto described as occurring in the Province, will enable some of the changes in part anticipated by Dr. Dawson to be foreshadowed with some degree of accuracy; and it is proper to repeat here Dr. Dawson's first paragraph of the "Explanation to the Geological Map:"—"The Map in this edition though greatly improved, is still to be regarded as merely a rude approximation to the truth, and the colouring in many places, more especially in the interior, remote from the coast lines, is little more than conjectural."

In various parts of 'Acadian Geology,' reference is made to rocks which were suspected by Dr. Dawson to be older than the Lower Silurian slates and quartzites, (see particularly page 620, Acadian Geology, 2nd edition.) These will probably now be classed with the Huronian series and the massive porphyroid granitoid gneiss on which they rest with the Laurentian.

Dr. Sterry Hunt visited Nova Scotia in November, 1867, "for the purpose of making some observations on the gold-bearing rocks of that Province, with the view of comparing them with those of other parts of the Dominion, and also of obtaining such information as might be useful in the event of a Geological survey of Nova Scotia itself." Dr. Hunt's stay in the Province was limited to four weeks in the months of November and December, and in the descriptions which he has given in his official report to Sir W. E. Logan,† he quotes the following as the principal sources of information about the geology and mineralogy of Nova Scotia: Dr. Dawson's Acadian Geology, 1st edition; Mr. Poole's report; Mr. Campbell's reports; Professor B. Silliman's reports on Tangier, Waverly, and Montagu gold districts.

The ancient stratified rocks of the gold region are described by Dr. Hunt as extending along the Atlantic coast for a distance of about 250 miles, from Cape Sable on the west to Cape Canseau on the east, with a superficies of about 6000 square miles, but this description is stated to be on the authority of the 1st edition of Dr. Dawson's Acadian Geology, coupled with the observations he was able to make during his brief

* Preliminary Report on a Gneissoid Series underlying the Gold rocks of Nova Scotia, and supposed to be the equivalent of the Laurentian system. Halifax, N. S., January, 1870.

† Report of Dr. Sterry Hunt, F. R. S., on the Gold Regions of Nova Scotia. Ottawa, 1868.

visit, and he adds, "further researches will doubtless enable us to extend and perhaps to modify, in some particulars, the statements here made with regard to the geology of the region, which still presents many points requiring further study."

Allusion is made in the Atlas of Maps and Sections of the Geological Survey of Canada to the opinions expressed in my report on New Brunswick, that much of the granites of that province consists of altered sedimentary strata:—"Much of what in Nova Scotia, New Brunswick, and Maine is represented on the map as intrusive rock (chiefly granite) probably consists of paleozoic strata altered in situ," as already suggested by Dawson and Hind. See the latter's report on New Brunswick, 1865, page 50." (Atlas of Maps and Sections, Geological Survey of Canada 1865, page 20.) The remarkable similarity which exists between rocks constituting part of the great gneissoid axis of New Brunswick and the gneissoid series now described of Nova Scotia, coupled with the equally marked similarity which obtains between the paleozoic strata resting on these gneisses in both provinces (on the Nipisquit in N. B.), satisfies me that they are the same age, whatever that age may be.

GENERAL SKETCH OF THE RELATION OF THE KNOWN GOLD BEARING ROCKS TO OTHER UNCONFORMABLE DEPOSITS IN NOVA SCOTIA.

The outcrop of a gneissoid series, supposed to represent the Laurentian and Huronian,* in Halifax and Hants counties, N. S., has been traced from a point seven miles west of Windsor on the Basin of Minas (Bay of Fundy) to the Atlantic coast at Cape Sambro, a distance of 48 miles in an air line, and 54 miles on the margin of the outcrop. This is the north east boundary of an immense area of the same rock series, which from information hereafter noticed, I believe continues with variable breadth to the Tusket Islands, near Yarmouth, a distance of about 135 miles, in an air line.*

The area above described, forms the western developement of the supposed Laurentian and Huronian gneisses and schists in Nova Scotia. It is separated from the eastern development by a narrow but profound valley occupied by Silurian strata, whose least breadth is eight miles. The outcrop of

* In this general sketch of the old Gneissic Rocks of Nova Scotia, they are grouped together. In succeeding paragraphs it is stated where the supposed Huronian or Cambrian Gneiss and Schist rest on the old Laurentian Gneiss, as far as known.

the south-western boundary of the eastern development is not continuous, but as shown on the map, embraces two areas near Grand, Fletcher, and Long Lakes, and an area near Parker's Lake, of unknown but very considerable and variable width, stretching with some narrow interruptions of Silurian strata which have escaped denudation, probably all the way to the Strait of Canso and Chedabucto Bay, a distance of 120 miles in an air line; so that, generally speaking, a Laurentian axis capped here and there by strata of Huronian age, occupies Nova Scotia, certainly in one place at least 48 miles in breadth.

The existence in Nova Scotia of all formations from the Trias to the Laurentian, with the exception of the Permian* may now be considered very probable. Whether the rocks noticed in the foot note are of Permian or Triassic age, I am not able to say, but judging from the descriptions given of the relations of the Triassic to the carboniferous by Dr. Dawson, I have hitherto considered small unconformable patches in Cape Breton as of Triassic age, and regarded them as the continuation of the Prince Edward Island series, resting on lower carboniferous rocks.

In the accompanying map the regular sequence is shown between the upper Silurian and the Laurentian, and the entire series from the lower Carboniferous, with the exception of the Devonian, is passed over in a journey by rail from Windsor to Halifax, in a distance of fourteen miles. The Devonian occurs at Nictaux, and rests there on upper Silurian slates,† which probably sweep round the Falmouth mountain, and connect with the upper Silurian shown on the map.

SEQUENCE OF FORMATIONS.

The Upper Silurian.

On the St. Croix River, eight miles from Windsor, the lower Carboniferous grits are seen to rest on what are pro-

* In Cape Breton, at Jumping Brook, seven miles north-east of Chetican Island, on the Gulf coast, and at Trout Brook, five miles north-east above Chetican, mottled sandstones and conglomerates rests unconformably on white and mottled sandstones and bituminous shales, supposed to be of lower carboniferous age. These latter rest unconformably, the first on red metamorphic rocks, the second are seen in close proximity to red, green, and black corrugated schists, supposed to be of lower Silurian age. In Dr. Dawson's tabular view of the geological formations of the Acadian Provinces, (page 19 Acadian Geol.) the Permian is stated to be "not represented unless by the lower part of the sandstones of Prince Edward Island. May not the unconformable patches in Cape Breton be a continuation of these Prince Edward Island deposits?"

† Page 498 Dawson's Acadian Geology. 2nd Edition.

visionally regarded as upper Silurian argillites. The grits dip N. 60° W. angle, 5°; the argillites S. 70° E., angle 50°. The argillites are generally very fine grained, green internally, but red weathering; they are interstratified with thin beds of quartzites, and have a breadth near the railway of 170 chains, their dip being tolerably uniform, and no repetitions visible; their thickness may approach 9,000 feet.

The argillites resemble in many particulars, argillites seen on the Tobique, in New Brunswick, and there associated with thin calcareous beds, holding *Favosites Gothlandica*. These are described in my Report on New Brunswick.* Towards the upper portion of the series the argillites are conformably succeeded by bluish black slates, holding cubical crystals of iron pyrites, and resembling roofing slates. A similar change occurs in the Tobique, in New Brunswick. These bluish black slates are exposed to a great extent on the Ardoise Hill range.†

The Lower Silurian.

A good exposure of the blue black upper Silurian slates is visible at the thirteenth telegraph post, south of Ellerhouse station on the Halifax and Windsor railway, dipping S. 20° E., and at the 38th telegraph post brilliant micaceous schists, overlaid by black corrugated slates, dip N. 40° E., the intermediate space being covered with boulder drift. The brilliant micaceous schists, as well as corrugated slates are much contorted, and overlie conformably the gold-bearing quartzite series.

The micaceous schists and the corrugated black slates can not be distinguished from similar schists and slates occurring on the Nipisiguit, and near Dumbarton station on the New Brunswick and Canada railroad in New Brunswick, where they are associated with the red slates, supposed to be the uppermost member of the Quebec group of Sir W. E. Logan.* The corrugated slates and schists contain conformable auriferous beds of quartz, but no mining is at present carried on in these deposits. They are about 3,000 feet in thickness. in the eastern part of the Province, but acquire double that thickness towards the western extremity. Underneath the black slates, the worked gold-bearing strata described subsequently, are conformably disposed. Their thickness being about 9,000 feet, the total thickness of the lower Silurian

* Page 131.

† The occurrence of a series of slates not differing widely from those on which they appear to rest unconformably, suggests the possibility of their being a repetition of the same series in the form of a synclinal fold. The underlying Argillites may also be the gold bearing series, less altered, than beds on the opposite side of the synclinal which are in close proximity to the gneiss. Until actual contact is discovered, this series is provisionally regarded as upper Silurian.

series, as far as ascertained in Nova Scotia is, from 12,000 to 15,000 feet. Some peculiarities in these deposit will be noticed further on.

The Cambrian or Huronian Series.

In some parts of Nova Scotia the known gold-bearing rocks rest unconformably on a gneissoid series, which are exposed to view on the Halifax and Windsor railway, between Stillwater and Mount Uniacke stations, but more especially near the village of Sherbrooke, in Guysborough county. This series is composed of beds of gneiss, interstratified with micaceous schists, schist conglomerate, beds of true quartzite, and grits. The gneiss is sometimes porphyritic, and the upper beds are almost always conglomerate, holding pebbles and masses of schist, grits, and conglomerates, which are found in this series. Some of the gneissic strata are garnetiferous, as are also the micaceous schists. Between Stillwater and Mount Uniacke stations the general strike of the lower Silurian is N. 80° E. dip N. angle 80°; the prevailing strike of the Huronian is S. 50° E., the railroad track running for two or three miles on the strike of these rocks. Near to their junction with the Huronian the Silurian strata are more altered than when remote from them, and hold numerous crystals of Andalusite. This series has been very extensively denuded, and in some places Silurian, Huronian, and Laurentian are seen in close juxtaposition. The thickness at Sherbrooke is about 1300 feet.

When the Preliminary Report, already referred to, was in the hands of the printer, I satisfied myself by repeated observations that a very decided unconformability existed between these supposed older strata and the gold-bearing series, also between the older series and the Laurentian; and I have succeeded in discovering in various places:

- 1st. The unconformable contact of the lower Silurian gold-bearing strata with the underlying gneissoid and schistose series;
- 2nd. The unconformable contact of this gneissoid and schistose series with the old porphyroid gneiss which I had before described as Laurentian;
- 3rd. The unconformable contact of the gold-bearing series with the old Laurentian gneiss, showing the absence of the intermediate gneissoid series, or the Huronian.

These several points of contact are visible at both extremi-

ties of a patch of Huronian strata about four miles broad, overlying the Laurentian on the Windsor and Halifax railway, commencing one mile or thereabout, south-east of New Stillwater station, and terminating at Uniacke's second lake, not more than half-a-mile west of Mount Uniacke station.

On the map showing the distribution of the Laurentian and Huronian in part of Halifax and Hants counties, two patches only of the Huronian series are indicated. The existence of other patches of Huronian are known to me along the indicated margin of the outcrop of the Laurentian, but so little is known respecting the extent, that I have preferred to mark only the position of two important areas, one near Mount Uniacke, the other forming the range of hills near Windsor.

The Laurentian Series.

The rocks last described are visible, as already stated, in unconformable contact with a coarse porphyroid, granitoid gneiss near Stillwater station. The strike of the granitoid gneiss is N. 10° W., dip W., at an angle of about 48 degrees. Five miles further south, and within a third of a mile of Mount Uniacke station, the Silurian quartzites rest on the Laurentian gneiss—the quartzites having a strike N. 75° W., and the old gneiss N. 20° W. Between Stillwater and Mount Uniacke, the Huronian series rests on the old gneiss, and the Silurian on the Huronian, but north of Stillwater and south of Mount Uniacke, the Silurian strata are in contact with the Laurentian gneiss, and so continue until another patch of Huronian is reached,—this last named series appearing to cover comparatively small areas in the great Laurentian valley between Halifax and Windsor, but in the more western counties it is exposed, I have reason to believe, to a very considerable extent.

In the county of Guysborough, the gold-bearing rocks at Sherbrooke rest on the Huronian, which, again, is seen close at hand to repose on the old Laurentian gneiss. In the middle and eastern part of Nova Scotia, the thickness of the Huronian does not appear to be very considerable, but no complete section has yet been crossed except at Sherbrooke. Between Halifax and Windsor, the lower Silurian series occupies a great valley or synclinal fold in the old Laurentian gneiss. The average breadth of the valley is nine miles and its depth must exceed two miles. Its general course is north-west (true), and the gold districts of Mount Uniacke and

Hammond's Plains are arranged on its western boundary, and those of Lawrencetown, Waverly, Montagu, and Renfrew, on the eastern boundary of the valley, occupying crowns of anticlinals, which have a general north-east by east direction.

In one part of the county of Guysborough the Laurentian, with a narrow band (as far as known) of Huronian, forms a nucleus, having an area of about 120 square miles. Around this nucleus the Gold districts of Cochran's Hill, Sherbrooke, Wine Harbor, Isaac's Harbor, and Country Harbor, are arranged, also on the crowns of anticlinals, which have a general easterly and westerly direction.

The profound Silurian valley shown in the map, between Halifax and Windsor, divides the Atlantic portion of Nova Scotia proper into two distinct geographical areas, in both of which the old porphyroid Laurentian gneiss forms the axis around which Huronian and Silurian series are arranged; but with respect to the precise limits of their formations little is known west or east of this area shown on the plan.

From Dr. Dawson's published maps and descriptions, Mr. Poole's manuscript map of the western part of the peninsula, and the numerous rock specimens collected by that gentleman, and placed at my disposal by the Commissioner of Mines, coupled with valuable information derived from other sources, I infer that this coarse Laurentian gneiss extends in one unbroken sheet of strata, but of variable width, a distance of 90 miles west of Windsor, and occupying a large portion of the uninhabited wilderness in that part of the province. Much of the gneiss, schist, and mica slates seen by Mr. Poole, and described in his Report, and illustrated by his specimens, together with the gneiss, mica schist, and chloritic beds alluded to by Dr. Dawson, and by that geologist long ago spoken of as probably older than the lower Silurian, are probably the representatives, in many instances, of the Huronian in the district where they occur.

In the autumn of 1868, Dr. Honeyman, then engaged on the geological survey of Canada, discovered on the Gulf coast of Nova Scotia in the Arisaig district, and near the base of the Antigonish mountains, syenites, diorites, and crystalline limestone with serpentine, which he states he then supposed of Laurentian age, as he informed me subsequently to the publication of my preliminary Report on the Nova Scotia Laurentian. Specimens were sent to Montreal for examination, and instructions were given by Dr. Hunt, who also shared Dr. Honeyman's opinion, to the lapidary, to prepare sections of the serpentinous rock for microscopic examination. By some mischance this was neglected, and the specimens remained unexamined and indeed forgotten, until quite recently, as

Dr. Hunt informs me, under date of Feb. 3, 1870.—When submitted to the microscopic test the *Eozoon Canadense* was distinctly seen.*

In other parts of Nova Scotia the Laurentian is yet known only in the form of coarse porphyroid gneiss; but the area it occupies is a lake and forest wilderness, frequented only by the lumberman and hunter.

Around its outcrop, and that of the Huronian, which appears to cap it at intervals, wherever the lower Silurian reposes we may expect to find new workable gold deposits occupying the crowns of the anticlinals which intersect the country with remarkable uniformity.

The portions of Nova Scotia which I have personally examined are shown on the accompanying maps of parts of Hants, Halifax, and Guysborough counties. In these the aspect of the series is distinguished by great uniformity, thick beds of coarse grained porphyroid gneiss being the characteristic rock. The description given by Sir W. E. Logan of a similar rock in the Laurentian of Canada, applies exactly to the characteristic strata in Nova Scotia: "The coarse grained granitoid and porphyritic varieties, which often form mountain masses, sometimes have, at first sight, but little the aspect of stratified rocks, and might be mistaken for intrusive granites."† I have found almost invariably when districts in Nova Scotia have been described to me as consisting of 'granite' that this coarse grained granitoid and porphyritic gneiss was the misnamed rock.

The remarkable similarity which exists between the rocks constituting the great gneissoid axis of New Brunswick and the gneissoid series in Nova Scotia, coupled with the equally marked similarity which obtains between the palæozoic strata resting on these gneisses in both provinces, satisfies me that they are of the same age.

* Some doubt appears to exist respecting the true character of this *Eozoon* as will be seen by reference to the foot note on page 3

† Page 587 Geology of Canada. 1863.

CAPE BRETON.

The undoubted recognition of the Laurentian limestones and Serpentine in the Arisaig district of Nova Scotia is of great significance and an important link in the chain of evidence which will ultimately establish the correctness of the supposition, that a great belt of rocks, the age of the Laurentian series, is exposed at short intervals apart, from Newfoundland in latitude 51° to Shelburne in Nova Scotia, in latitude 44° .*

In Cape Breton, I saw in 1866, the black corrugated slates forming the summit of the gold-bearing rocks of Nova Scotia, about four miles north of Cheticamp Island—and on the MacKenzie River, near Red Cape, I crossed part of a great gneissoid series as represented on the accompanying plan, where the strike and dip are shown. In various parts of Cape Breton, I have seen similar gneisses, as for example near the mouth of North River; St. Ann's Bay, and on the peninsula opposite Baddeck. Dr. Honeyman informs me that he considers the gold-bearing rocks of Middle River of the same age as those of Nova Scotia. Hence it becomes more than probable that a large portion of the area colored by Dr. Dawson as upper Silurian in northern Cape Breton, is of Huronian and Laurentian age.

PROBABILITY OF GOLD IN THE HURONIAN OR LAURENTIAN GNEISS.

The uniform distribution of gold throughout the Silurian quartzites and slates in Nova Scotia viewed in connection with the origin of these deposits, renders it probable that auriferous deposits, veins and dykes will be found in the underlying gneissoid series, which have constituted the chief source of the material from which the gold-bearing quartzites and slates were elaborated.

Hence, the search for gold in the popularly misnamed granites of Nova Scotia, is by no means likely to result in disappointment. On the contrary, judging from the occurrence of a zone of auriferous deposits in Ontario in the Laurentian series, and of gold in the "granites" of Australia, the probability that mining districts will be successfully established

* Vide page 11 Preliminary Report.

in the Laurentian and Huronian of Nova Scotia, becomes of sufficient importance to merit not only serious discussion, but also systematic search.

Mr. Brough Smyth* states that in Victoria the granites of the colony, at or near their junction with the older sedimentary deposits, contain gold. The precious metal is also found in the syenitic diorites of the colony. "It is necessary," says Mr. Smyth "to bear these facts in mind: they have a value altogether independent of their significance in geological investigations, because they may lead to explorations which will add to the permanent wealth of States." Granite dykes in which quartz veins exist extremely rich in gold, also contain the metal.

AURIFEROUS ZONE IN THE LOWER LAURENTIAN OF ONTARIO.

In Ontario, Sir W. E. Logan has indicated the position of an auriferous zone in the lower Laurentian. In a summary Report of progress in Geological investigations, dated 1st May, 1869, Sir Wm. Logan states as follows:—

"For the last three seasons the attention of Mr. H. G. Vennor has been bestowed upon the investigation of various rocks which are spread out in the counties of Addington, Hastings, and Peterboro', in the province of Ontario, and which have been more than once mentioned in previous reports. Their lithological characters and economic contents were given in some detail in the Report of Mr. Thomas McFarlane for 1866. Ores of iron, lead, copper and antimony were then known to be found in them, and to these have since been added, gold, silver, and bismuth."

"After much research in tracing out the distribution of these rocks, Mr. Vennor has been able to determine the geological structure of the district and the stratigraphical relation of the iron and gold.

The series consists in descending order of the following general divisions:—

1. Calc-schists, dolomites, mica slates and siliceous slates, the latter two characterized by extensive lenticular masses of conglomerate with pebbles of quartzite gneiss and green stone, at the base of which there appears to be an auriferous band.

* The Gold Fields and Mineral Districts of Victoria, page 286.

2. Hornblendic, pyroxenic and chloritic slates, characterized at the bottom by passing occasionally into beds of magnetic iron ore of commercial importance, and succeeded in some places by gray and red granitic gneiss, and hornblendic schists, interstratified with bands of crystalline limestone.
3. Syenitic rocks, varying in color from flesh red to brick red, and forming the base on which the rocks appear to rest throughout the district.

This series lies in a general synclinal form between the counties of Addington and Peterboro', with a breadth of about thirty-five miles, which has been traced to the north-eastward from the position where it emerges from beneath the overlying lower Silurian rocks on the south-west, to within half a mile of the York branch of the Madawaska River, a distance of about forty-five miles. Many subordinate undulations striking to the north-east, and affected by transverse geological depressions and elevations, cause the distribution to assume a very complicated figure, presenting a number of basins in the upper division, more or less united with one another, the intricate outline of which can only be made intelligible by being represented on a map.

The iron ore beds of Belmont, Marmora, and Madoc, which have often been separately described in previous reports, are found to be on the same horizon with one another, at the base of the upper division, while the localities in which gold has been discovered, appear to show an auriferous zone at a short distance above the iron belt, the separation between the two being seldom more than the breadth of half a lot, or between three and four acres.

The Calc-schists are in one or two places marked by the presence of *Eozoon Canadense*, and anorthosite rocks have been found rising above the upper division in isolated masses; but from the difficulty of finding any marks of stratification in them, it can scarcely be decided whether or not they are conformable, and before the question whether the Hastings series belongs to the upper or lower Laurentian can be satisfactorily determined, further investigation will be required. Provisionally the series is classed with the lower Laurentian."

Dr. Sterry Hunt, in a Report under date January, 1867, addressed to the Hon. Commissioner of Crown Lands, on the Gold region of Hastings, Ont., describes at some length the gold-bearing rocks of this county, and considers probably that they are an upper member of the lower Laurentian series.

"This series of rocks," says Dr. Hunt, "many thousand feet in thickness, appears to be conformable with the adjacent

coarsely crystalline gneissic strata, which form a continuous part of the great Laurentian area of Canada and northern New York. These rocks of Hastings thus appear to be a portion of the true Laurentian series, in proof of which they are in the township of Lake, apparently overlaid unconformably by rocks bearing the mineralogical characters of the anorthosites of the Labrador or upper Laurentian series. To these facts is moreover to be added the evidence of organic remains. The *Eozoon Canadense*, which characterises the uppermost or Grenville band of the Laurentian limestones, on the Ottawa, has been detected in the grey fine grained limestones of Hastings; in a fragmentary condition in Madoc, and more recently in a large and well defined shape, on the weathered surface of a similar limestone in Tudor; in both cases, however, filled, not with serpentine, but with carbonate of lime.

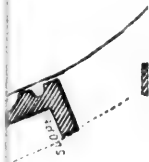
"Although these rocks have been traced over a considerable area, it is not yet certain whether their distribution is due to a synclinal or an anticlinal form. In the latter case they would be an older series than the other Laurentian rocks of the region, and probably than any others as yet examined in Canada. If, however, as seems more probable, they occupy a synclinal, they will represent an upper member of the true or lower Laurentian, and it will then remain to be decided whether these Hastings limestones belong to a higher position of the system than any yet examined in the Ottawa district, or whether they are the equivalents of the Grenville band, of which they contain the peculiar fossils. In this case, their peculiarities, both in texture and mineral characters, must be regarded as due to original local differences.*"

* Report on the Gold Region of the County of Hastings. By Dr. Sterry Hunt.

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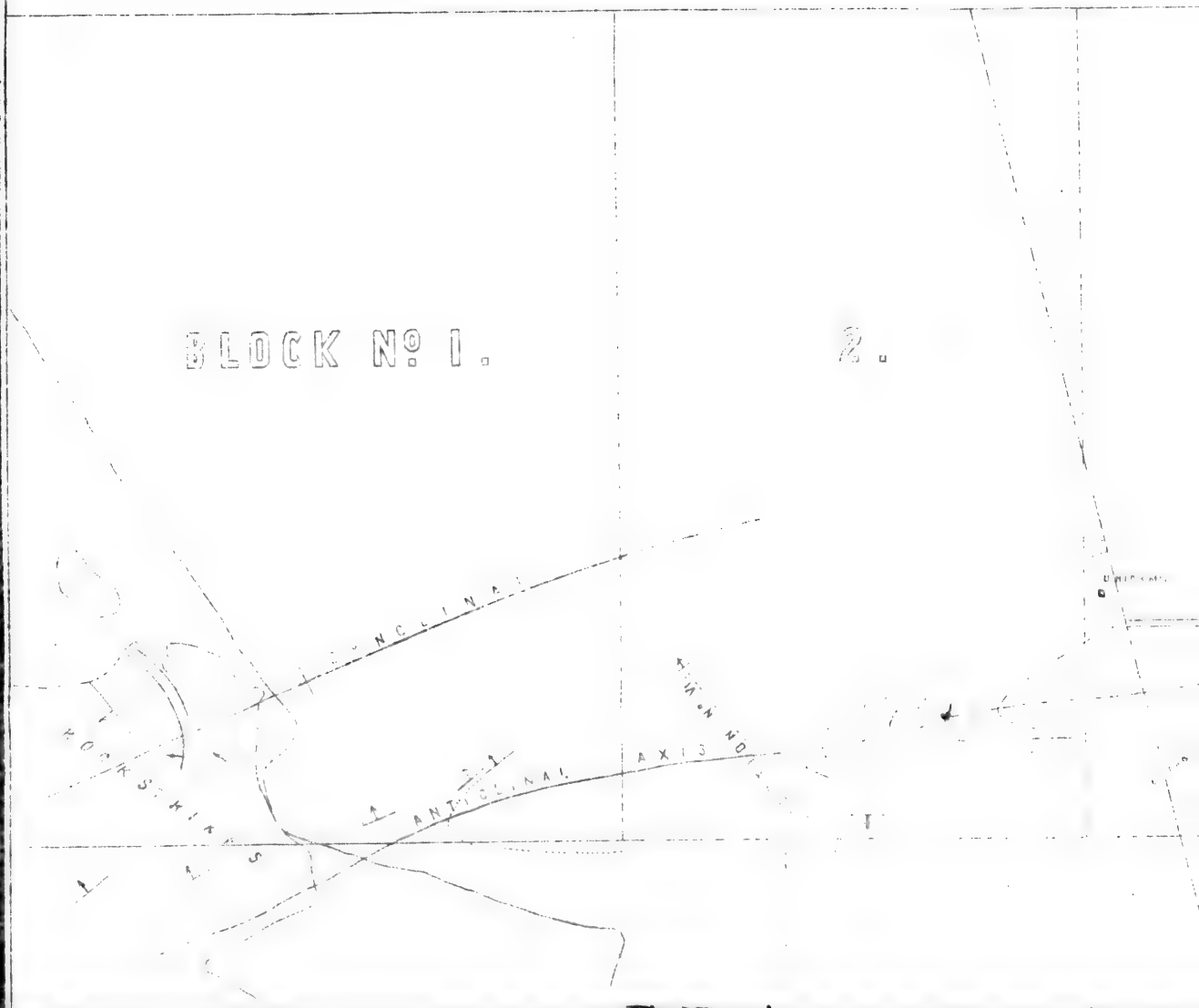
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*For Details see enlarged Plan of Blocks II
To accompany a report on the
BY HENRY Y. HIND M.A.*

BLOCK N° 1.

2.



A Plan of Blocks III & IV & Plan of Roosting
 a report on the district
 RY Y. HIND M A





GASPEREAU, LAKE S

BLACK SLATE

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SECTION NO IV.

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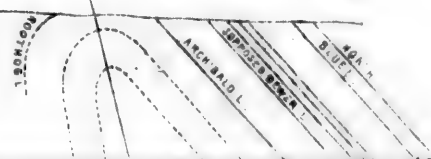
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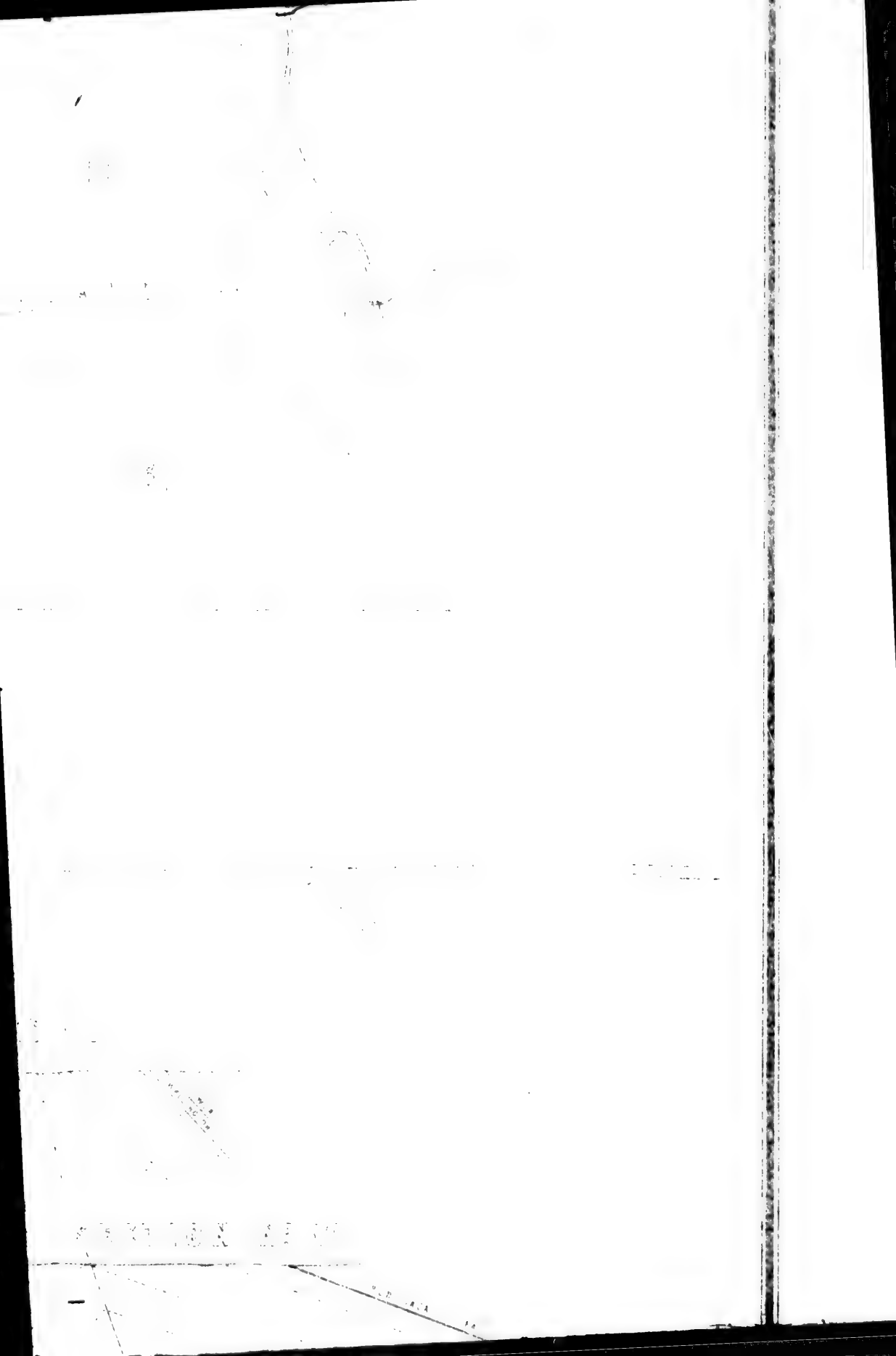
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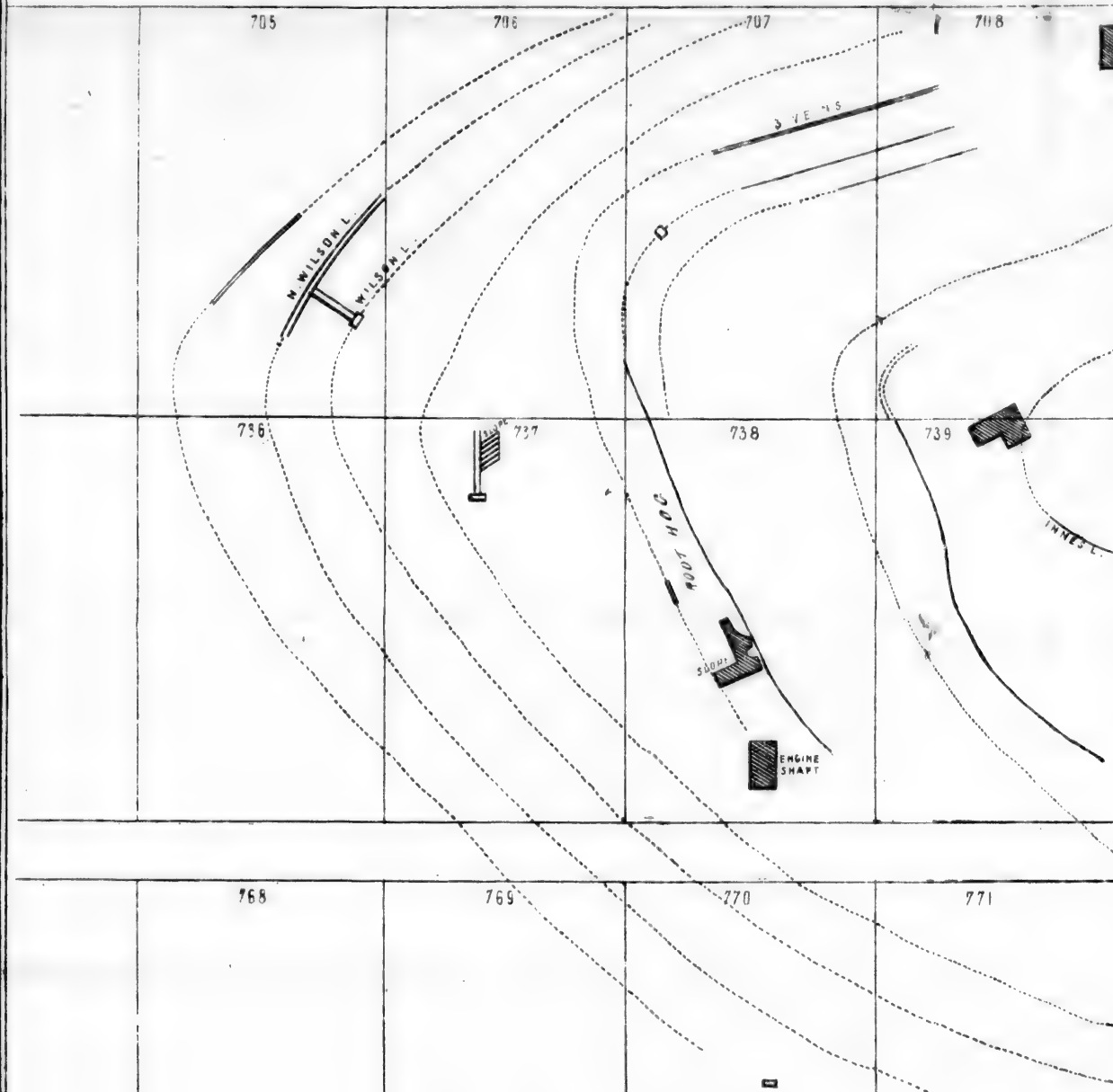
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SECTION NO. V



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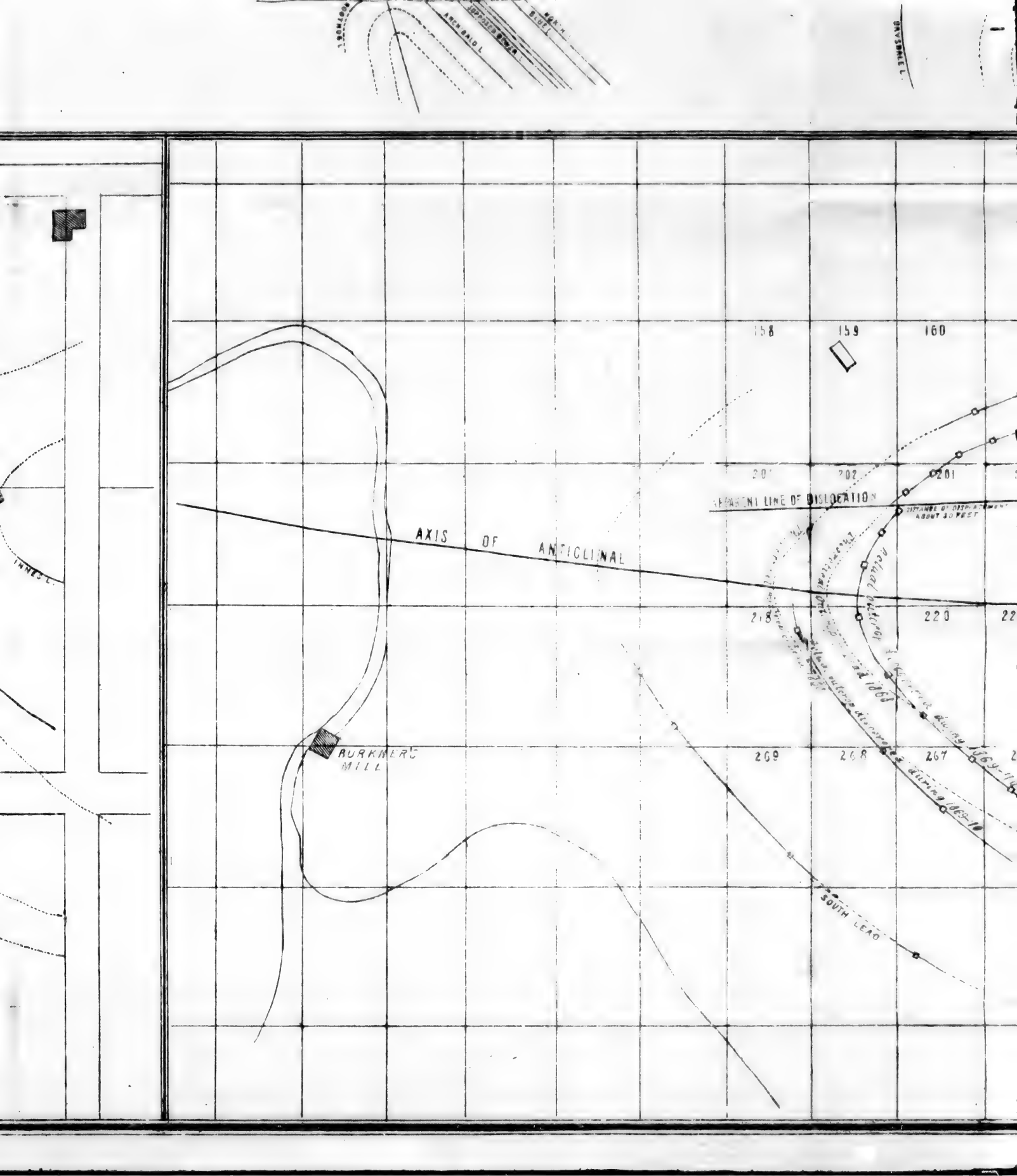


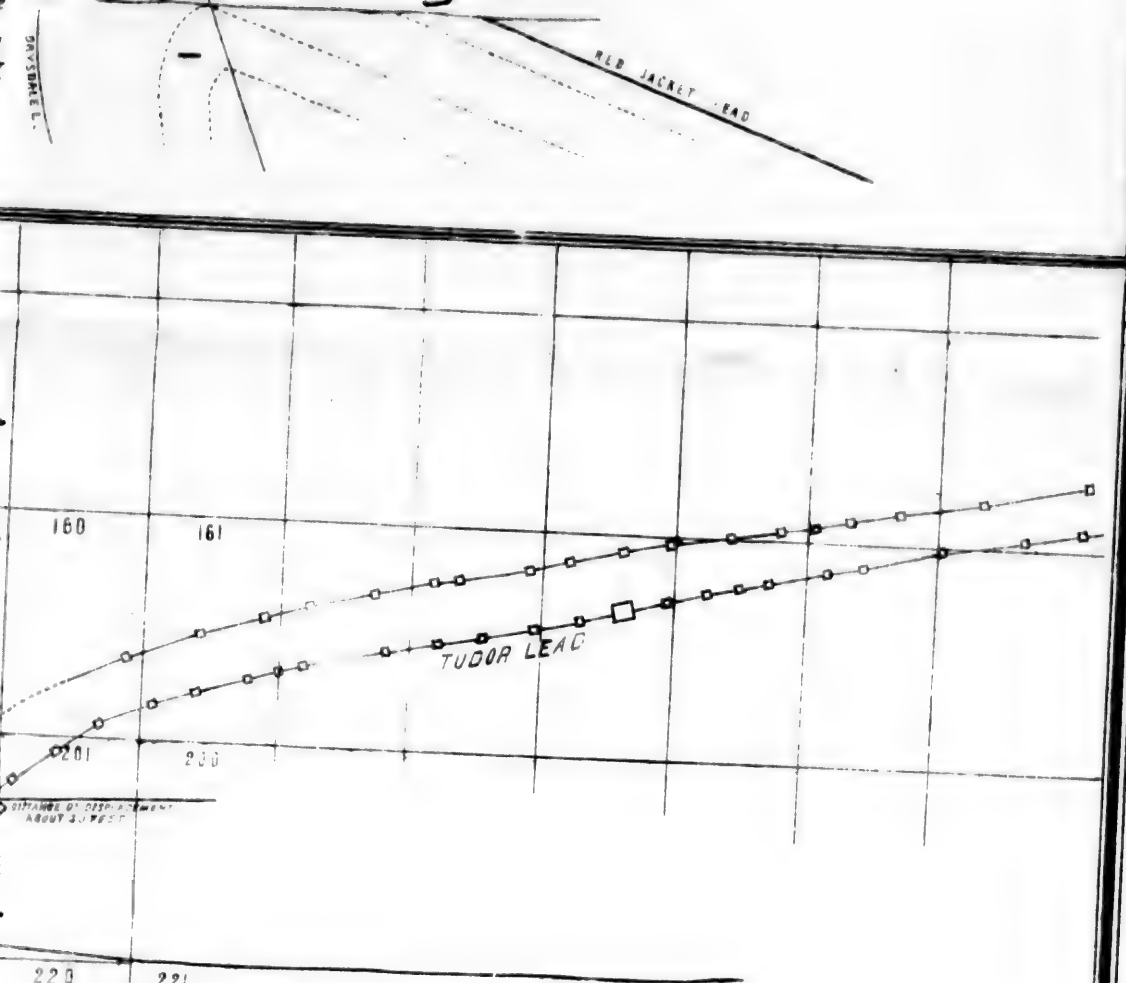
PLAN OF THE RROOTHOG

AND ADJACENT LEADS AT SHERBROOKE

From a survey by Mr Wm Barnes Mining Engineer,

SCALE: 100 FEET ONE INCH

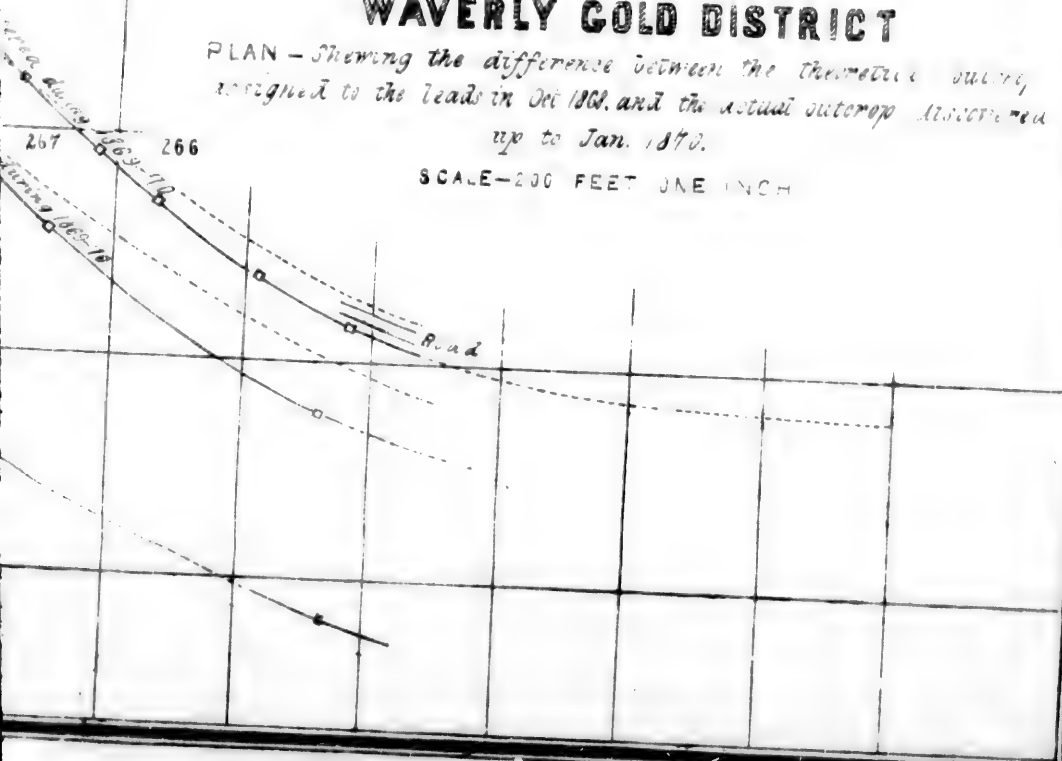




WAVERLY GOLD DISTRICT

PLAN - Showing the difference between the theoretical outcrop assigned to the leads in Oct 1868, and the actual outcrop discovered up to Jan. 1870.

SCALE-200 FEET ONE INCH





THE SHERBROOKE GOLD DISTRICT.

The Gold district of Sherbrooke is situated about twelve miles from the mouth of the St. Mary's River, in the county of Guysborough. Its geological relations are shown on the accompanying map. A broad nucleus of old gneiss, part of which is brought up by a fault, representing, it is supposed, the Laurentian series, has a narrow band of Huronian (Cambrian) rocks encircling it, and on these the nearly vertical edges of strata of the lower Silurian slates and quartzites. With beds of auriferous quartz are seen to rest. On areas 625, 74, block 7, the attitude of the quartzites is such as to convey the impression that they have slid over the surface of the gneiss during the folding. The section exhibited by a bold cliff, shows the gold-bearing strata dipping north at an angle of about 70 degrees, with their edges resting on felspathic gneiss dipping south at an angle of 45 degrees. The edges of thin alternating beds of quartzite, slates, and quartz repose on sheets of gneiss which have been broken by faults, and this form of contact can be seen at intervals for a considerable distance.

On the road from Sherbrooke to the Indian Harbor Lakes, the quartzites are sometimes, but rarely, seen to be penetrated by granitic veins, as well as near the head of the Indian Harbor Lakes, about four miles from Sherbrooke.

But the edges of the beds of quartz which exist in the gold-bearing Silurian rocks on Lynch's mountain to the east of Sherbrooke village, rest, like the slates, on the gneiss and terminate at the point of contact, apparently having no connection with any granitic veins penetrating the series, none having been recognized near the worked lodes. From six to eight hundred yards east of the areas, whose numbers are given in the foregoing paragraph, a bold precipice averaging one hundred feet in altitude, rises like a wall, and extends for more than a mile. A similar and parallel wall of equal altitude stretches from the head of the Indian Harbor Lakes some miles to the southward. It is composed of coarse porphyroid granitoid gneiss. Near it, as represented on the map, part of Guysborough county, the red gneiss of this supposed Huronian series has crushed through the Silurian quartzites and contact is visible about an eighth of a mile from the head of the last of the Indian Harbor Lakes.

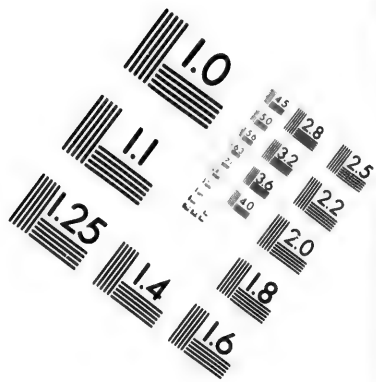
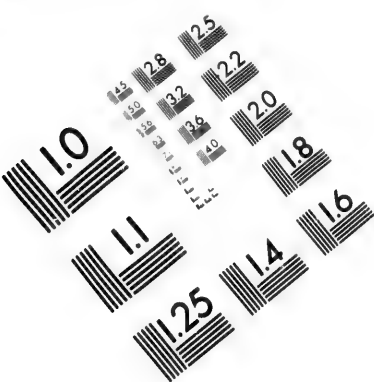
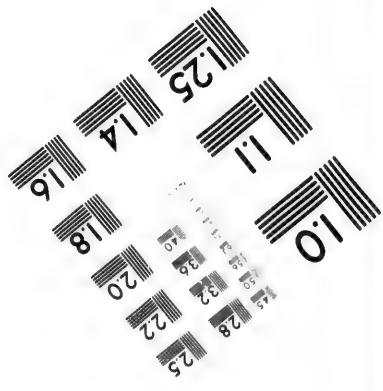
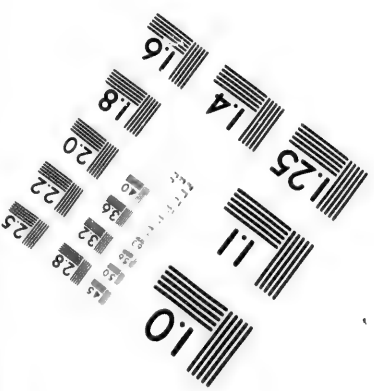
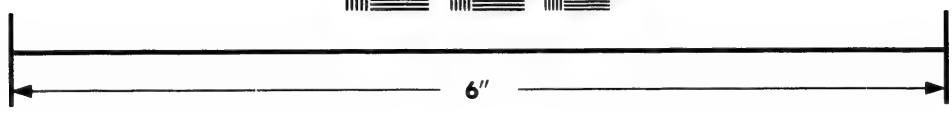
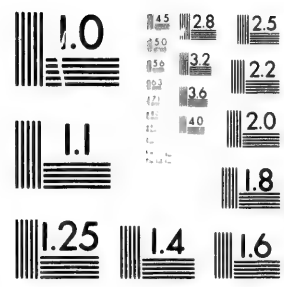


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THE ANTICLINAL AXIS.

If a slightly undulating line be drawn from area 775 on the E. side of the St. Mary's River to Gaspereaux Lakes, a distance of about 8000 yards on a course north 75 degrees west (magnetic) it will represent part of the axis of the Sherbrooke anticlinal. On the north side of the axis, the strata and lodes dip to the north at an angle generally of about 45 degrees, except when approaching the axis, when they begin to curve. On the south side the dip varies from 80 degrees to vertical, except when approaching the axis.

Proceeding south from the axis, the lodes become more persistently vertical until they acquire a slight northern dip, thus showing that the form of the anticlinal is that of an overturn to the south as represented in the sections.

On making the curve at the apex of the ellipse, some of the lodes sweep gradually round with a dip varying from 80 degrees south to 60 degrees south-west, 35 degrees south-west by west, 26 degrees west, then gradually increasing in dip until they acquire the normal depth of about 45 degrees north. The plan of the Root Hog shows this curvature with some degree of detail.

The accompanying plan of Sherbrooke district exhibits the general course of the anticlinal. On the large plan in the office of the Mines Department, the areas through which the anticlinal is supposed to pass are numbered in such a manner that the approximate position of the axis can be easily determined.

Subjoined are the numbers of a few of the areas where the axis will very probably be found; the nature of the curvature is also indicated.

WEST SIDE OF ST. MARY'S RIVER.

Block 4.—Number of area 667—sharp curve, dip on north side, N. angle 45 degrees. On south side S. angle 80 degrees.

This character appears to be maintained through areas 668, 669, 670, 641, 642, 643, 644, continuing on a course S. 75 degrees E.

In Block 3, the axis is found on areas 717 and 718, here, however, it appears to be less abrupt and the contour of the rock exposures begin to show the curvature with considerable accuracy. This is especially the case on area 712, and from this point to the Root Hog and for a considerable distance beyond, the curvature is broad and tolerably well defined.

Where the curvature is sharp and abrupt, as on area 667, Block 4, it is very probable that attempts to find the unbroken

continuity of a lode will rarely be successful in consequence of small faults or displacements on the line of axis. These are indicated by the brecciated structure of the rock. At the Root Hog (see plan) and on many areas west of this, the curvature is continuous, but the crown of the anticlinal is broad, and not sharp and abrupt as on and near area 667, before mentioned.

From the Root Hog to Gaspereaux Lake, the crown of the anticlinal increases in breadth, and at the Gaspereau Lakes it merges into a synclinal which shows itself on the north side, and is visible on St. Mary's River, some distance beyond the limits of the district.

The general course of the Sherbrooke east and west anticlinal is, as already stated, north seventy-five degrees west, magnetic, but the variation of the compass being twenty-two degrees west, the true course of the anticlinal is seven degrees to the south of west, or north 83 degrees east.

Mount Uniacke Gold district, 100 miles to the west, bears a remarkable similarity in geological structure to Sherbrooke, the true course of this anticlinal is north sixty-four degrees east, thus showing a difference between the ranges of these anticlinals of about twenty degrees. The Mount Uniacke anticlinal representing the general course in the gold districts of Hants county; and Sherbrooke those of Guysboro' county around the nucleus of gneissic rocks shown on the plan.

DISLOCATIONS.

There are at least two sets of main dislocations at Sherbrooke, with minor dislocations generally parallel to one or the other of the main dislocations. The course of one of these is nearly north magnetic. The other set has a course about N. 70 degrees W. One set appears to be dependant upon the east and west anticlinal, the other set on the north and south anticlinal,* the axis of which lies some distance to the east of Lynch's mountain, about half a mile to the east of St. Mary's River.

The principal dislocations are shown on the plans of Sherbrooke district.

THE LODES AT SHERBROOKE.

The Sherbrooke lodes are beds of auriferous quartz, many of

* For a description of these Anticlinals, at the intersection of which most of the Gold districts are situated, see Report on the Waverley Gold district by the author, Halifax, 1869.

them of contemporaneous age with the associated quartzites and slates. Some of them are intercalated, and consequently of later age than the contemporaneous beds. Generally speaking, however, they resemble in structure and association the lodes at Waverley, and the same remark applies to nearly all the districts in Nova Scotia. The strata with which they are interstratified are continuations of those already described in my report on the Waverley district, with such modifications as might be expected where continuations of the same strata are found at distances so far apart.

In the vicinity of the gneissoid series, and in some districts *e. g.* Cochran's Hill, the quartzites and slates are much metamorphosed and not unfrequently assume a schistose and a gneissoid character. These metamorphosed beds are especially observable near the city of Halifax, and close to the junction with the gneiss at Mount Uniacke. Many of the specimens contained in Mr. Poole's collection exhibit great metamorphosis and resemble so closely similar specimens from the districts named, that hand specimens placed side by side cannot be distinguished by their appearance. Probably, in most instances, the observed metamorphosis indicates proximity to the lower gneisses. In no instances have I noticed intrusive rocks, which might have produced the change.

The coarse quartzites or grits occur from Gold River to Sherbrooke, and probably far beyond these places to the eastward and westward.

The ferruginous black corrugated slates appear to limit the quartzite series over the entire province. There is, however, a great difference in the degree of metamorphosis hereafter noticed, to which the same strata in different districts have been subjected, but, with respect to Sherbrooke, no difference in this respect occurs between this district and Waverley, Lawrencetown, or Mount Uniacke.

The outcrops of the lodes at Sherbrooke, like those at Waverley, are arranged in the form of very elongated concentric semi-ellipses, the base of the semi-ellipse terminating at the junction of the Silurian strata with the Huronian (Cambrian) gneiss on Lynch's mountain. On page 11 of the Report on the Waverley Gold district, I stated that the strata at Waverley were "arranged in the form of a long elliptical dome." It would have been more in accordance with the general structure if I had said, "in the form of a denuded half of a long elliptical dome," as shown on the plan. The outcrops of the lodes and strata are stated on page 15 of that Report to be in the form of concentric halves of ellipses. These at Waverley have their bases (axis minor of the ellipse) resting on the gneiss of Parker's Lake. In the same manner the base of the Mount Uniacke semi-ellipse rests on the Huronian

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gneiss as shown on the map. The inclination of the grain of the strata due to the north and south anticlinal at Sherbrooke is 45 degrees west on Lynch's mountain, and diminishes by successive steps to 12 degrees west, which occurs in block 2, on area 917, a distance of 19,200 feet, or about $3\frac{1}{4}$ miles from the junction of Silurian quartzites and Huronian gneiss.

The step marking the diminution in the westerly dip of the grain of the rock, or tilt of the east and west anticlinal, is probably due to faults, which appear to be uplifts, so that a recurrence of part of the same lodes with their associated beds of slates and quartzites in proceeding from east to west, is more than probable. There is a great fault near the Union Mill, marked on the plan, which has brought to the surface strata resembling the beds near and a little west of the post office at Goldenville, that future identification may be anticipated.

An inspection of the sections will show the dip and relation of the lodes on each side of the anticlinal, but no positive evidence exist at present to enable the statement to be made that, generally, particular lodes worked on one side of the anticlinal are identical with particular lodes worked on the opposite side, unless continuity has been established by actual workings. The similarity of the metals is in some instances very marked and sufficient to lead to the opinion being held that certain lodes are very probably the same, but in no instance to my knowledge can this statement be made with absolute certainty, except where the lode has been actually traced round the curve and continuity established. That a group of lodes worked on one side of the anticlinal is identical with a group worked on the other side, may be stated with perfect sincerity, and as a natural consequence, it may be asserted that such a group on the south side was, before denudation, continuous with the corresponding group on the other side. But until particular lodes have been opened up round the curve, opinions as to continuity must be of a purely speculative character. This arises from the structure of the lodes. In many instances they are not continuous for very long distances, that is to say, they thin out and take up again. In some cases, as shown on the plan, the same leads can be traced even at the surface for many hundred yards, and instances occur where they can be traced for miles, but it is safe to assume that generally they resemble, as stated in my report on the Waverley Gold district, thin lenticular sheets of quartz whose edges not unfrequently overlap one another, especially in bands of slate. I do not wish to be understood to say that there are no lodes which can be traced round the curve and their identity with lodes on the opposite side of the anticlinal established; not only does experience prove

this to be contrary to fact,* but the structure and origin of the lodes render it highly probable. But I think it very advisable to point out the reasons why disappointments might arise if this expectation were to be entertained with regard to every lode.

In making crosscuts at some distance below the surface, lodes are frequently cut which do not appear in the surface trenches. And in broad bands of slate, lodes thicken to the breadth of 10 to 12 inches and thin out to a film of quartz or disappear altogether in the space of a few hundred feet. But before they thin out altogether, another lode begins to appear separated from the first by a few inches, more or less, of slate or quartzite. This cannot be strictly regarded as a continuation of the lode which has 'thinned out,'—although it may thin out, and be in part overlapped by another lode in the strike of the first one which had disappeared. Some lodes of this description appear to belong to the class of intercalated lodes, that is, they are sheets of quartz that have been formed at a later date than the enclosing rock, and were produced by the replacement, particle by particle, of pre-existing beds of some other soluble material. In lodes of this class, which generally occur in slate, the slate itself is found to be auriferous, and the whole mass is frequently worth crushing.

The strong persistent lodes, generally occur in quartzites, or with quartzites on one side and slate on the other. The intercalated lodes occur in slate, with sometimes thin beds of quartzite, which are also intermittent, that is 'thin out' and 'take up' again.

The intercalated lodes are to be distinguished from lodes which occur in disturbed portions of the strata, as well shown on the free claim at Renfrew, where short and well defined sheets of quartz, rich in gold occur round the curves of a sharp twist in the strata. These lodes hold much carbonate of lime, and some of them abound in specular iron. These lodes are noticed in my report on the Waverley district, page 25.

Recent operations in the Gold district of Waverley have afforded very satisfactory proofs of the contemporaneous bedded structure of many of the Nova Scotia lodes, of the general structure assigned to the districts, and of their occurrence at the intersection of cross anticlinals as represented in the plan of the recovered Tudor and North lodes at Waverley and in the district plans of Waverley and Sherbrooke.

These proofs are thus referred to by the Chief Commissioner of Mines in his report for last year†: "The most

* See letters in Appendix relating to the Tudor lode, &c., at Waverley; also, plan of the Tudor and South Lodes.

† Report of the Chief Commissioner of Mines for the Province of Nova Scotia, for the year 1869. Halifax, 1870. Page 9.

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noticeable feature in this district is the tracing of the southern outcrop of the celebrated Tudor lode, by a series of openings connecting two points eleven hundred feet distant, and thus proving the correctness of the views entertained by Professor Hind of the geological structure of this district, as described in his report and fully exemplified in the map accompanying that report." They are also referred to by Mr. Rutherford, the Inspector of Mines, who states in the same annual report: "The trending of the strike of this lode towards the north and east has been followed from the shafts to within a few feet of the old workings on the Tudor lode, and its identification with that lode been established; and the construction assigned by Professor Hind to this part of Waverley district confirmed."*

The Lodes in Nova Scotia may be grouped as follows:—

1. THE BEDDED LODES, consisting of beds of quartz, interstratified with the slates and quartzites, and of contemporaneous age with them. These are the most abundant and from them a considerable proportion of the gold is obtained.
2. THE INTERCALATED LODES.—These almost always, as far as known, occur in slates, and are most numerous in broad bands of slate varying from 10 to 70 feet in width. Where these lodes abound, it would be profitable to crush both slate and quartz, for gold is not unfrequently found in the slate. The best illustrations of the intercalated lodes occur at Sherbrooke and Wine Harbor.
3. THE GASH LODES, occurring where the strata has been locally squeezed out of place, also on broad bands of quartzite. Instances are known in various districts, but the most important are those already mentioned in connection with the free claim lodes at Renfrew.
4. TRUE LODES OR VEINS, cutting the strata. Some of these are very rich, but those which have been worked have proved very narrow. From their origin it is to be supposed that this class of quartz will yet yield very important returns. The irregularity of true lodes is well known and the fact that hitherto, this class has yielded comparatively inconsiderable results, should not discourage operations, for true lodes frequently thin out to a mere film of quartz, and increase to the thickness of several feet within a vertical distance of a few fathoms.†

The origin of the intercalated lodes is obscure, but the con-

* Report of the Chief Commissioner of Mines for the Province of Nova Scotia, for the year 1869. Halifax, 1870. Page 38.

† For additional notices of the character of the leads see my Report on the Waverley Gold district, pages 22-27.

ditions required for their formation appear to be in a great part satisfied, if we suppose that they represent lines of minimum pressure during the folding, denudation and faulting of the strata.

Along the lines of minimum pressure the strata are necessarily more porous than where their particles are pressed closely together and consolidated by the superincumbent masses bearing upon them. Large areas of minimum pressure must occur during the slow formation of a fold whether it has an anticlinal or synclinal form. If the fold were perfectly uniform no such areas would be produced, but as the plications of the strata, however large, are very far from uniform, and often assume that of an overturn with an irregular axis, it is not difficult to conceive that numerous areas of minimum pressure are produced coincident with the stratification. Along such lines the flow of aqueous currents would be determined, and particle by particle of soluble strata be removed, and in their place other particles be deposited, by the ordinary process observed in the replacement of one mineral by another.

Intercalated lodes are most commonly found as already observed in the slates or softer strata. These in the folding would be most likely first to yield to forces acting in different directions during the folding, and the process of intercalation would continue until the aqueous currents were diverted into some other channel opened for them by the same cause, namely, a minimum pressure.

According to this view, the formation of intercalated lodes is continually going on, for the pressure upon any given point at any given depth is continually changing, owing to denudation and other causes constantly operating although in no form perceptible to the senses.

The slow elevation and subsidence of a wide extent of country may be alone sufficient to produce variations in the pressure on any portion of strata whether folded, or inclined, and thus determine the flow of aqueous currents.

In this manner we may account for the formation of the short intercalated lodes on the free claim at Renfrew. The innumerable intercalated sheets of quartz in the great slate bands at Sherbrooke and Wine Harbor; the bulging out of bedded lodes in one place and thinning to films of quartz or their total disappearance in another. The passage in a zig-zag form of a bedded sheet of quartz from one plane to another, as seen in several instances at Mount Uniacke and in other districts, without any dislocation of the strata; the pre-existing minerals having been removed and their replacement by silica occurring on the line of minimum pressure.

Other phenomena may be accounted for on the same hypo-

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thesis. At the Wellington mine, in the Sherbrooke district, and elsewhere, the slates are characterized by numerous small elongated concretionary forms enclosing particles of arsenical iron pyrites, and symmetrically arranged on the face of the laminae of the slates. These particles all point in one direction; they are about two lines in length and one in diameter. Whatever determines the flow of aqueous currents will also determine the movement of minerals, and consequently of the gold.

The same reasoning which is applicable to the formation of intercalated lodes, may render it doubtful whether any bedded lode not clearly a fissure lode, can strictly be regarded as altogether a lode of contemporaneous age with the enclosing rock. The statement that it is so, may apply to certain portions of such a lode, but it is difficult to conceive that during the infinity of changes of pressure which must have occurred in any given area, aqueous currents may not have been successively determined towards every part, and caused a greater or less displacement of particles. The same currents which would affect the lodes would also affect the wall rocks, and it may be that by such agents the distribution of particular minerals in certain lines of disposition has been occasioned. The motion of particles in the strata long subsequent to their consolidation is shewn in the regular arrangement of crystals and nodules of arsenical iron pyrites, cubic pyrites and other minerals. The peculiar corrugations of the Barrel quartz and the enclosing rocks may be occasioned in the same way. The corrugated quartz is generally, though not always, found on the crown of anticlinals, which would represent areas of minimum pressure.

It is, however, in the broad belts of slates, where the intercalated lodes are numerous, and the gold is sometimes found in films between the laminae, that we find the most suggestive support of this explanation of their origin. Both at Sherbrooke and Wine Harbor, and to a less extent at Waverley, the slates showing this class of lodes are nearly vertical, on the steep side as it were of the anticlinal. The strata on the opposite side being inclined at an angle of about 45 degrees, if a lateral pressure operated during the folding, or at any time subsequently to the assumption of an anticlinal or synclinal form, the lines of minimum pressure would be on the steepest side and the softest strata would yield the most, thus determining the flow of aqueous currents through the more porous or least compressed. Such a lateral pressure would necessarily occur during the folding of the north and south anticlinals, which occurred after the east and west anticlinals were produced. The faulted structure observed in all the districts examined were probably occasioned at the same period.

MINING ECONOMICS AT SHERBROOKE.

Mr. R. Brough Smyth in his work on "The Gold Fields and Mineral Districts of Victoria," states that "the records of the Mining Department show that the average yield of gold from quartz crushed at Ballarat is very low. This, instead of having a prejudicial effect on mining operations generally, has been singularly beneficial. It has induced economy in working, brought into use, and to completeness, many excellent appliances for saving fine gold, and has served to train managers and workmen better, and more effectually than any Mining school teaching could do."

Mr. Symth gives instances of the successful and profitable manipulation of quartz, which in Nova Scotia would be considered practically impossible, simply because nothing comparatively is known in that Province of economical manipulation.

At one mine in Ballarat 7,453 tons of quarts yielded no more than 2 dwts. $10\frac{1}{2}$ grs. per ton, yet the company paid in dividends £2,101 10s. The quartz was easily obtained, and at small cost, but the manipulation was very economically conducted. At the Black Hill Mine, Ballarat, the total quantity of quartz crushed up to 1868 was 190,118 tons, yielding 22,801 ozs. 18 dwts. 13 grs. The average yield being 2 dwts. 9.7 grains per ton.

The lode is of great thickness and the cost of getting out the quartz is, for open cutting 4s. 2d. per ton, from levels; through shafts 8s. 6d. per ton. Cost of crushing 4s. per ton. Wages 7s. 6d. per diem, for miners 8s., second 7s. 6d., boys 6s.

The stamps are provided with self-feeding apparatus, and the occasional attendance of one boy is sufficient for supplying the whole battery of 60 stamps with the material brought to the hoppers. Amalgamating troughs and blanket strakes are employed for collecting the fine gold. Hot water is used. The gold obtained from the different parts of the reduction machinery averages about 75 per cent. from the stamp boxes; 25 per cent. from the Mercury troughs; 5 per cent. from the blankets.

From the year 1862 to 1868, the quantity of quartz crushed in Nova Scotia is returned at 147,680 tons; the quantity of gold at 139,118 ounces, which amount to 19 dwts. per ton nearly.

In Victoria the yield of gold from 5,811,669 tons of quartz crushed during a period of 10 years (from 1859 to 1868) has averaged 11 dwts. 12.37 grains. *

* The Gold Fields of Victoria.

The average yield of gold in Nova Scotia is 15 dwts. 16 grs. per ton, and in Victoria 11 dwts. and 12.39 grs. The excess of the average in Nova Scotia over the yield in Victoria from crushed quartz amounts to more than 4 dwts. Notwithstanding this large proportion in favor of Nova Scotia quartz, yet the mining interests are depressed while those of Victoria are buoyant.

The cause of this apparent anomaly is readily explained. In Nova Scotia we are passing through that stage of blundering incompetency which has already visited Australia and California, and from which those countries have emerged with wonderful strength and aptitude, for the circumstances in which they are placed.

In California* "the greatest common blunder in quartz mining, and the most common error in early times as well as in our own day, has been that of erecting a mill before the vein was well opened and its capacity to yield a large supply of good rock established. The commission of this blunder is proof conclusive of the utter incompetency of the author to have charge of any important mining enterprise."

Even in California comparatively little progress had been made in quartz mining up to 1860; and in 1868 Mr. Ross Brown states that no country in the world can show such wasteful systems of mining as prevail in the United States; that of the claims recorded in the settled parts of the country and known to be valuable, not more than one in a hundred is being worked; and of those worked, perhaps not more than one in fifty pays anything over expenses, owing to mismanagement, inefficiency of systems of reducing the ores, want of capital, cost of transportation and other causes susceptible of remedy. He considers that, "at a moderate calculation, there has been an unnecessary loss of precious metals since the discovery of the mines of more than \$300,000,000, scarcely a fraction of which can ever be recovered." "Our mines and mills are practically managed by foreign experts; we furnish the labor and mechanical ingenuity, but they furnish the scientific skill." †

In the official Report on the mineral resources of the United States, the general condition of Gold Mining in California is represented as that of decline with regard to the alluvial or placer leads, and on the increase with a promising future with respect to quartz mining;‡ after, however, having passed through a state of depression due to "gross blunders both in

* Report on the Mineral Resources of the United States. J. Ross Brown.

† J. Ross Brown, Mineral Resources of the United States, 1868, page 10.

‡ Ibid.

mining and milling." Of the quartz mills built within the last four or five years, the successful proportion is much larger than in 1860. This is attributed to increased knowledge of the business, and more careful supervision. The blunders are being gradually corrected, "and if they were not still quite common, the quartz mines of California would yield nearly twice as much as they do. The business will never be established upon a proper basis until the Superintendents, as a class, are well educated chemists, and mining and mechanical engineers, and the mine owners frequent visitors, if not regular residents, at the mines."

Hence, we need not be surprised that the Nova Scotia mines, which, although the quartz yields on an average 15 dwt. 16 grs. per ton, are in a condition of temporary stagnation, while those of Victoria, which gives but 11 dwts. 12-37 grs., to the ton, are active and flourishing. In Victoria, according to Mr. Smyth; "whether the vein is wrought by sinking shafts and driving from thence, or by tunnels, or by quarrying on the surface, all the best appliances, as used in other mining countries, are bought into use by our miners, who in perseverance, skill and intelligence are not excelled by the same class in any country." In Nova Scotia, the fatal error of erecting mills before the auriferous worth of the quartz is known, is common, and there are two new mills now lying idle at Sherbrook, which have not yet crushed one hundred tons of quartz from the mining property they were constructed to serve.

The economy displayed in the management of the mine and the manipulation of the material now common in Australia and California, is utterly unknown in Nova Scotia. The tailings alone in most of the districts contain on an average more gold than the quartz crushed at some of the paying mines at Ballarat. In no instances, to my knowledge, are any artifices employed in Nova Scotia beyond the battery and shaking tables.

After the tailings have passed over the tables they are allowed to escape as best they may.

In a new mill recently constructed at considerable expense at Cochrane Hill, facilities are offered for the rapid flow of the tailings into the lake, after they have passed through a 'trap' which the inventor is contented to "know" arrests all the gold. These tailings are here as elsewhere in Nova Scotia loaded with arsenical iron pyrites, and analysis shows not only that the pyrites is rich in gold, but that a considerable quantity of gold from pyritous quartz escapes amalgamation.

Mr. Kirkpatrick has kindly furnished me with the table subjoined, showing the results of his analyses of Arsenical Pyrites from different lodes at Wine Harbour and Sherbrooke:—

within the much larger knowledge of blunders are still quite yield nearly be established, as a class, mechanical engineering not regular

Nova Scotia average 15 tary stagna- dwts. 12-37 n Victoria, wrought by nels, or by as used in our miners, not excelled tia, the fatal irth of the w mills now crushed one y they were

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he table sub- nical Pyrites oke:—

	PER TON.					
	Yield of Gold.			Yield of Silver.		
	Oz.	Dwts.	Grs.	Oz.	Dwts.	Grs.
WINE HARBOR.						
Assay of pure Arsenical Pyrites from } Provincial Co.....	11	8	16	..	..	..
SHERBROOKE.						
Assay of pure Arsenical Pyrites and } Galena from Boulder Lot.....	4	1	16	8	19	10
Assay of pure Arsenical Pyrites (no } Galena) from Cobourg Co.....	1	12	16	6	10	16
Assay of pure Arsenical Pyrites from } Kingston and Sherbrooke Co.....	4	18	..	5	14	8
Assay of pure Arsenical Pyrites from } Canada Co.....	45	..	..	..	..	..
Assay of pure Arsenical Pyrites from } Wentworth Co. (Ferguson lode)..	..	16	8	..	..	..
Assay of pure Arsenical Pyrites from } Meridian Co. (Sears lode).....	1	12	16	9	..	..
Assay of Concentrated Tailings (ave- } rage)	2	10	..	..	..	..

The following tables are very suggestive. They point to a branch of Gold Mining industry which may be said to be wholly unknown in Nova Scotia. The tailings in this province, as already stated, are allowed to accumulate without any effort being made to extract the gold they contain, which not unfrequently (vide report on the Waverley District) amounts to 33½ per cent. of the entire quantity of gold contained in the quartz. Under the term "cement" the following substances are included, 'conglomerate,' 'quartzite,' quartz gravel, with an argillaceous, silicious or ferruginous cement; auriferous

rous pudding stone; under the term "Mullock" Rubbish, dirt, stuff taken out of a mine—the refuse after the vein stuff is taken away; pyritous slate, &c., &c.

Table showing the average yield of gold from certain parcels of quartz tailings, cement, mullock, &c., crushed in the years 1864 to 1868 inclusive in the several Mining Districts of Victoria.*

MINING DISTRICT.	Quantity Crushed.		Total Produce.		Average per Ton.		
	Tons.		Oz.	Dwts.	Ozs.	Dwts.	Grs.
Ballarat.	92,408	6	9,699	14	0	2	2.38
Beechworth.	7,904	16	1,415	17	0	3	13.97
Sandhurst.	441,592	0	85,123	8	0	3	20.52
Maryborough.	115,137	10	30,946	3	0	5	9.01
Castlemaine.	238,357	0	53,503	13	0	4	11.74
Ararat.	97,669	0	23,382	14	0	4	18.91
Gippsland.	445	0	69	12	0	3	3.00

These facts will appear incredible to those who are accustomed to say that the careful preservation and manipulation of the tailings "will not pay." It is, however, the secret of the success which attends the Victoria miner. Economy in every department, skill in the niceties of manipulations, with as careful attention devoted to apparently the most insignificant details as is shown in a well ordered and efficiently superintended mercantile establishment. Until this system is adopted in Nova Scotia, it is idle to suppose that gold mining will be generally remunerative.

The following tables show that the annual averages produced in Victoria and Nova Scotia, are considerably in favor of the latter. And this result is obtained notwithstanding the imperfect manipulation of the quartz. The inefficiency of the machinery, the entire neglect of tailings, the simple articles, such as blanket strakes, settling tubs, buddles, &c., which are used to arrest the fine gold.

At the Port Philip and Colonial Gold Mining Company's works, Victoria, the following is the return of quartz crushed for the 12 months ending September, 1865:

Quartz.	Gold.	Average per ton.
54,413 tons.	20,596 oz., 10 dwts., 12 grs.	7 dwts., 13 grs.

The gold was collected in the following way:—

Stamp beds.	66.08 per cent.
Mercury boxes.	22.95 "
Blankets.	10.97 "

* The Gold Fields and Mining Districts of Victoria.

' Rubbish,
e vein stuff
certain par-
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Districts of

At the Good Hope Mine, Crooked River, the crushed quartz falls over two rows of ripple-boxes, which are charged with 65 lbs of quicksilver each to the four head of stamps, (twelve stamps in all, driven by a 10 horse-power engine). The tables are covered with blankets. Those on the upper end of the tables are changed every two hours, and on the lower every four hours, and are washed by hand.

The tailings, after leaving these tables, pass to a percussion table. The pyrites, &c., are washed and passed through a Chillian mill. The alloy is moved by hand from the top of the quicksilver in the ripple-boxes.

The returns for the week will serve as an illustration of the relative proportions of gold saved by the different steps in the manipulation:

verage per Ton.

s. Dwts. Grs.
0 2 2.38
0 3 13.97
0 3 20.52
0 5 9.01
0 4 11.74
0 4 18.91
0 3 3.00

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artz crushed

verage per ton.
wts., 13 grs.

per cent.

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Amount of Quartz crushed.	Amalgam.				Total.	Gold.
	Stamp beds.	Boxes.	Blankets.	Alloy.	Amalgam.	
	Oz. Dwts.	Oz. Dwts.	Oz. Dwts.	Oz. Dwts.	Oz. Dwts.	Oz. Dwts.
Tons, 42	55 10	95 12	34 0	28 0	213 2	127 2

Descriptions in detail are given of the different modes of saving the gold from crushed quartz in Phillips' Mining and Metallurgy of Gold and Silver, and in Mr. Brough Smyth's work a large amount of valuable information respecting the mining economics in Victoria will be found. Guido Kustel, in his "Treatise on Concentration of all kinds of Ores," describes numerous methods of saving gold, which are wholly unknown in this Province.

Kustel says that Battery Amalgamation (universally employed in Nova Scotia) can not be considered a proper way of saving gold.

THE GOLD STREAK.

In the report on the Waverley District, the disposition of the gold in certain zones in the quartz lodes was noticed. At Sherbrooke the same peculiarity exists, on the north side of the anticlinal the dip of the zone or streak is to the west, at an angle of about 35 degrees in the plane of lode; on the south side the dip is nearly vertical, but slightly to the east in the plane of the lode, as might be supposed from the circum-

stance of the form of the anticlinal being that of an overturn to the south.

As observations accumulate with reference to the gold streak the importance of a better knowledge of the subject becomes more evident. At Isaacs' Harbour the gold streak dips to the east at a high angle in one of the lodes, and when projected it has the form of a very acute triangle. In sinking some hundred feet east of the rich auriferous zone in the lode, with a view to strike it at a depth of about 300 feet, the miners at Isaacs' Harbour came across another and parallel streak. At Montague, as stated in the report on Waverley, there are two parallel zones on the belt lode.

In California the gold streak is known by the name of "pay chimneys," and Mr. Ross Brown describes the want of knowledge respecting "pay chimneys" as one source of the discouraging results of quartz mining in California during its early stages.

Professor Silliman states that "the rich chimneys or productive zones of ore ground are known to be of various extent in quartz veins, from a few feet to many hundreds of feet, and it is impossible to assign any valid reason why we may not expect the same changes in a vertical direction which we find in an horizontal." (Quoted by Ross Brown.)

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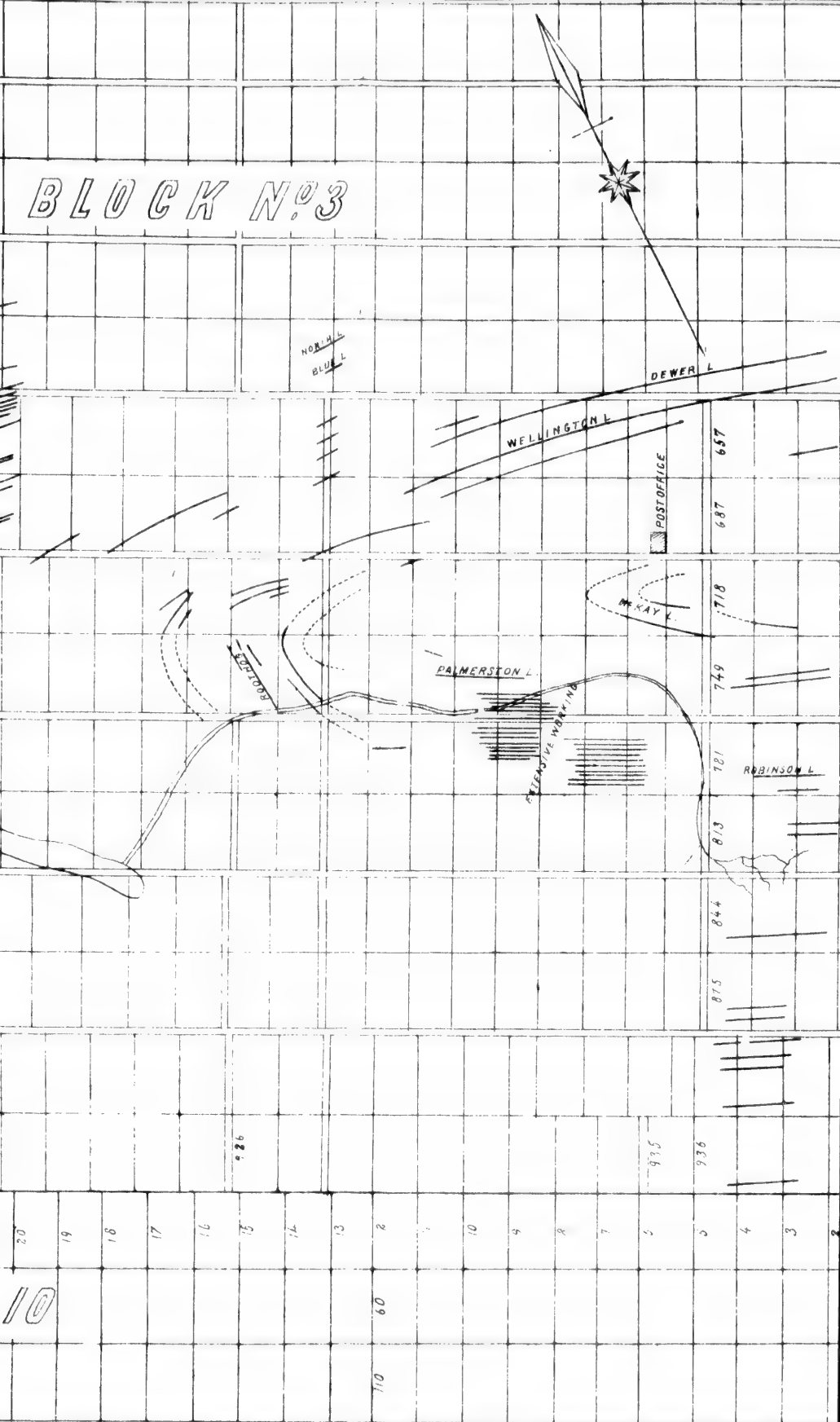
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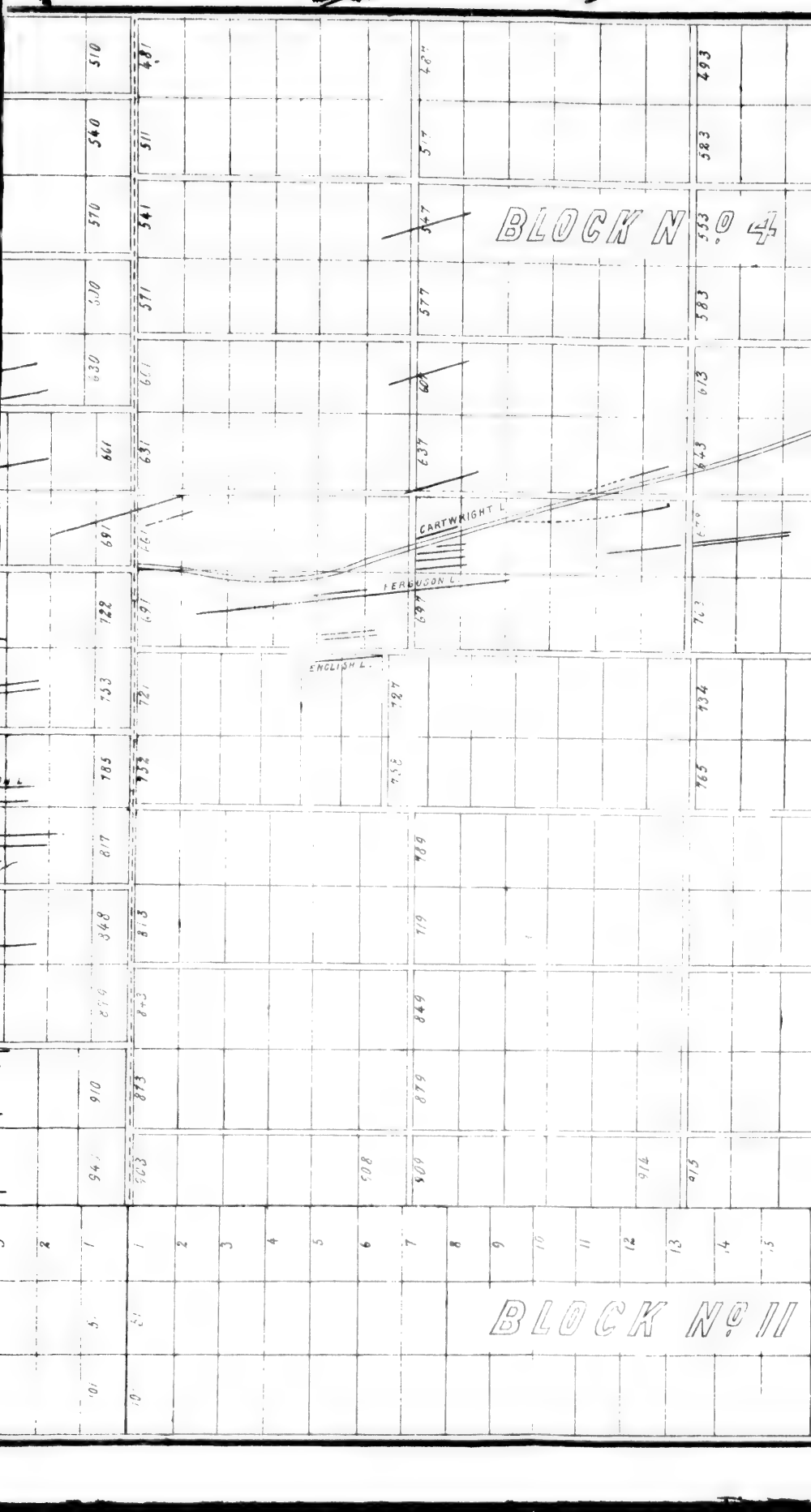
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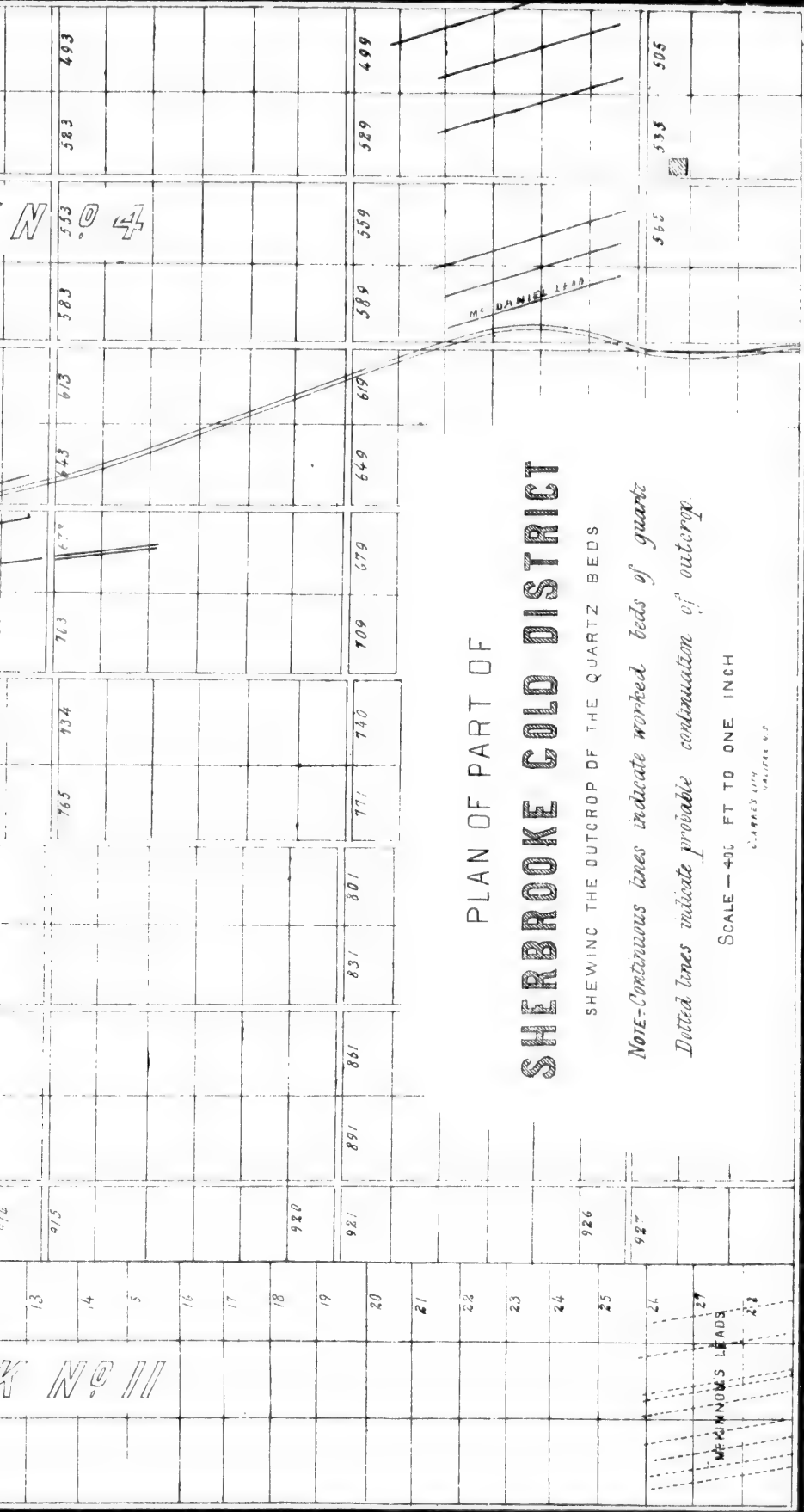
BLOCK N° 4

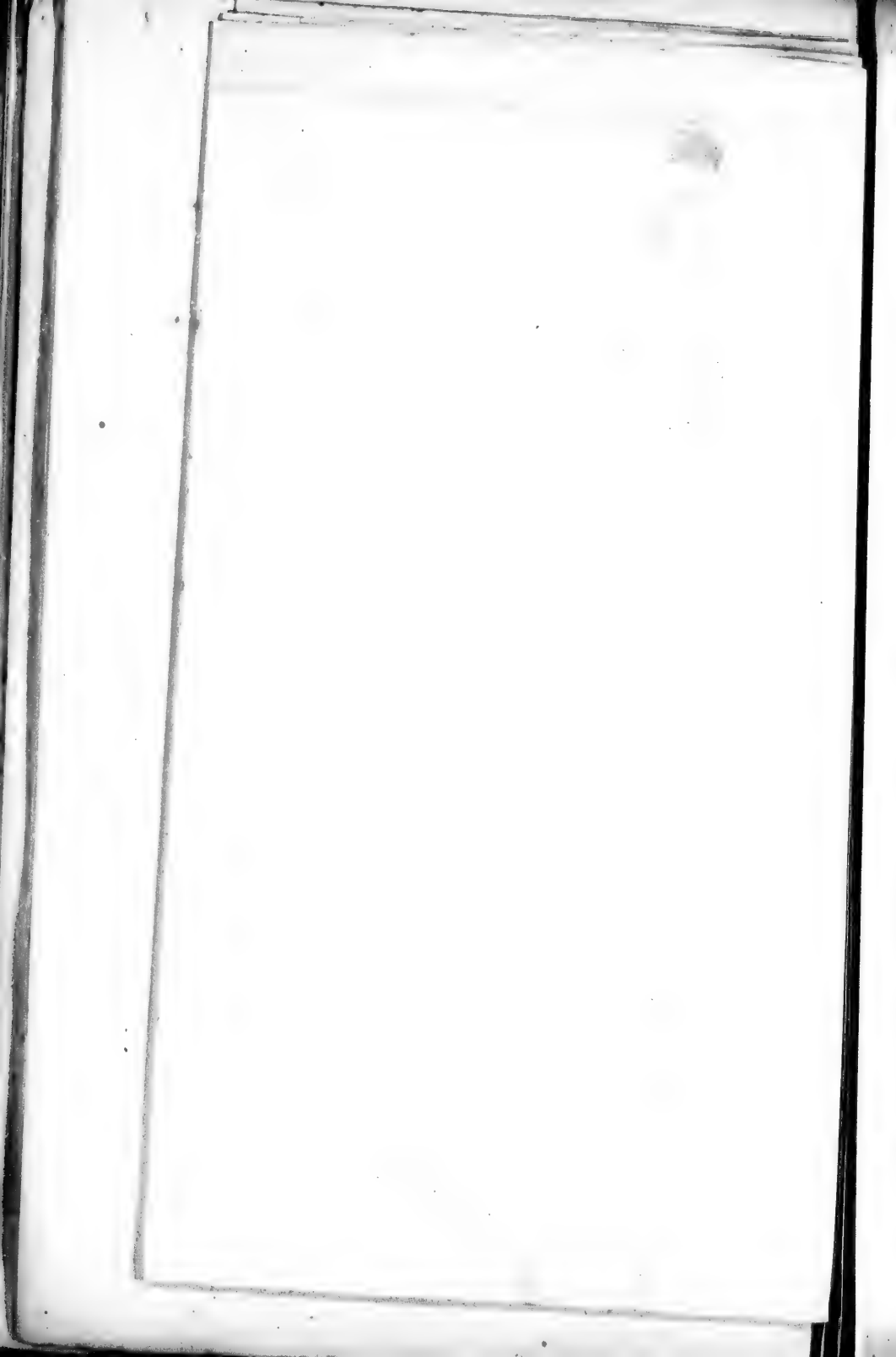
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CARTWRIGHT L.

FERGUSON L.

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DETAILS OF SHERBROOKE GOLD DISTRICT.

The following tables contain the details of the returns from Sherbrooke District, extracted from the records of the Department of Mines. With each return the number of the area is associated, and in Schedules at the close the areas are grouped according to the numbers of the mining leases to which they belong:—

Statement of Quartz raised and Gold obtained from Sherbrooke Gold District during the year 1863, as shown by the Quarterly Returns for that year.

No. of Lease.	No. of Areas.	QUARTZ CRUSHED.		GOLD PRODUCE.			REMARKS.
		Tons.	Cwts.	Ozs.	Dwtls. Grs.		
No. 49	776, 809, 810, 811, 840 to 843, 874, Block 3	1359	14	258 77	10 10	{ }	77 ozs. 10 grs. obtained otherwise than from the crusher.
14	627, 628, 656, 657, 624, to 626, Block 3..						
85	721 to 726, 752 to 757, 783 to 788, 813 to 818, Block 4, and 751 to 753, Block 3..	97	5	44	13 10		
86	616, west half of Block 3						
18	677 to 679, 647 to 649, Block 3	8	5	4	10 22		

Statement of Quartz raised, &c., for 1863.—Continued.

No. of Lease.	No. of Areas.	QUARTZ CRUSHED.		GOLD PRODUCE.			REMARKS.
		Tons.	Cwts.	Oz.	Dwts.	Grs.	
74	745 to 747, 714 to 716, Block 3.....	194	9	472	18	5	{ 10 tons of which were tailings from which 4 dwts. were obtained.
75	617, Block 3.	57	8	33	9	19	
34	674 to 676, 644 to 646, Block 3.....	6	0	4	10	10	
7	525, Block 4.....	22	10	34	5	12	
2	750, Block 3.....	21	6	38	10	18	
21	703, 673, 674, 643, 644, Block 4.....	149	16	222	15	02	
27	680 to 682, 650 to 652, Block 3.....	66	0	5	15	10	
26	775, Block 3.....	36	15	21	2	13	
24	671, Block 3.....	1	5		12	11	
25	738, do.	1	14		3	4	
91	749, Block 3.....	277	14	458	6	8	
50	615, Block 3.....	10	10	4	14	13	
47	683 to 685, 653 to 655, Block 4.....						
67	748, 717, Block 3.....	30	00	1	8	16	
66	741, Block 3.....	1	3	0	8	4	
96	621, Block 3.....						

66 741, Block 3.....	30	00	1	8	16	{ 10 tons of which were tailings from which 4 dwts. were obtained.
96 621, Block 3.....	1	3	0	8	4	

111 East half 14-30th of 616, Block 3.....	112	13	646	6	12	{ 616 Block 3, owned by two parties and included in two leases west $\frac{1}{2}$ in lease 86, and east in lease 111.
41 711 to 713, 742 to 744, Block 3	27	6	5	10	16	
68 739, Block 3.....	1	00	0	3	6	
	2482	13	2336	6	9	

Statement of Quartz raised and Gold obtained from Sherbrooke Gold District during the year 1864, as shown by the Quarterly Returns for that year.

No. of Lease.	No. of Areas.	QUARTZ CRUSHED.		GOLD PRODUCE.			REMARKS.
		Tons.	Cwt.	Oz.	Dwt.	Grs.	
2	750, Block 3.	62	18	68	14	13	{ The areas contained in these leases will be found in the table for 1863.
111	14-30 616, Block 3.	151	17	500	17	7	
1485 } and } 86 }	.....	86	5	124	9	10	
25	738, Block 3	36	15	19	6	9	
27	680 to 682, 650 to 652, Block 3	102	0	233	18	7	
47	683 to 685, 653 to 655, do. 4	683	6	749	0	18	
75	617, Block 3	48	13	38	9	14	
82	622, do.	9	0	3	2	14	
86	West half of 616, Block 3.	281	15	726	7	2	
No lease.	{ 658 to 661, 688 to 690, Block 3, 601, } 603, 631, 632, 571, Block 4. }	6	12	2	8	18	
109	623, Block 3.	90	12	194	13	5	
49	776, 809 to 871, 840 to 843, Block 3.	388	6	59	18	6	
115	606, Block 4.	6	14	5	5	17	
99	617 and 618, Block 3	73	3	34	14	22	

109 623, Block 3.	90	12	194	13	5
49 776, 809 to 871, 840 to 843, 874, Block 3.	388	6	59	18	6
115 606, Block 4.	6	14	5	5	17
99 617 and 618, Block 3.	73	3	34	14	22

34 674 to 676, 644 to 646, Block 3.	112	17	51	5	18
No lease 707, Block 3.	0	10	0	18	4
94 889, Block 2.	8	13	8	13	0
116 641, 642, 643, 672, 673, Block 3.	53	19	205	11	19
{ 570, 600, 630, 614, and 615 Block 3. }					
{ 659, 688, 689, 718, 719 Block 2. }					
103 677 to 679, 647 to 649, Block 3.	27	14	16	14	4
No lease. 604 Block 4.	69	5	69	15	22
523 to 526, 494 to 496, Block 4.	3	2	1	18	0
92 607, Block 4.	3	4	1	16	18
No lease. 666, do	1	0	0	13	12
560 to 564, 590 to 593, Block 3.	6	6	3	2	3
113 704 to 706, 735 to 737, Block 3.	3	7	3	4	17
No lease. 671, Block 3.	1	0	0	7	21
595 to 599, 627, Block 3.	2	0	1	5	12
99 618, Block 3.	1	0	0	10	0
No lease. 693 to 695, 663 to 665, Block 4.	6	12	1	5	12
562, 563, 592, 593, 677 to 679, Block 4.	19	19	1	12	18
95 776, Block 3.	2	0	0	3	0
No lease. 668, Block 4.	1	0	0	5	8
783 to 785, 815 to 817, Block 3.	1	10	0	2	4
	22	3	39	8	13
	2374	17	3170	1	7

Statement of Quartz raised and Gold obtained from Sherbrooke Gold District during the year 1865, as shown by the Quarterly Returns for that year.

No. of Lease.	No. of Areas.	QUARTZ CRUSHED.		GOLD PRODUCE.			REMARKS.
		Tons.	Cwts.	Ozs.	Dwts.	Grs.	
No.	27	413	17	888	4	13	
	103	360	6	117	5	16	
	100	0	9	0	11	3	
	141	18	14	2	0	22	
	142	14	0	1	0	8	
No lease.	599, 600, Block 2; 571 to 573, Block 3...	9	10	0	11	19	
	47	741	0	832	4	19	
	116 { 641 to 643, 672 to 673, Block 3..... }	1	0	1	6	8	
No lease.	707 and 738, Block 3.....	145	12	370	9	0	
	131	18	18	44	5	8	
	24	18	0	6	0	0	
	123 { 570, 600, 630, 614, 615, Block 3; 659, {	57	7	117	10	2	
	688, 689, 718, 719, Block 2..... }	84	3	201	19	22	
	124	20	8	13	14	0	
No ease	624, 625, 656, Block 3.....	21	10	12	3	13	
	616, Block 3.....	12	0	3	9	5	

" 782 to 785, 815 to 817, Block 3.....

123	688, 689, 718, 719, Block 2.....	84	3	201	19	22
124	718 and 749, Block 3.....	20	8	13	14	0
No ease	624, 625, 656, Block 3.....	21	10	12	3	13
	616, Block 3.....	12	0	3	9	5

"	782 to 785, 815 to 817 Block 3,.....	3	5	2	6	....
109	623, Block 3.....	25	0	37	16	22
27	650 to 682, 650 to 652, Block 3.....	389	0	871	18	22
No lease.	663 to 665, 693 to 695, Block 4.....	9	17	3	13	7
67	717 to 748, Block 3.....	36	0	56	6	12
No lease.	631, Block 4.....	1	10	2	3	2
"	658 to 661, Block 3.....	60	5	4	1	20
"	671, Block 3.....	26	9	52	14	5
		2482	0	3643	17	8

Statement of Quartz raised and Gold obtained from the Sherbrooke Gold District during the year 1866, as shown by the Quarterly Returns for that year.

No. of Lease.	No. of Arcas.	QUARTZ CRUSHED.		GOLD PRODUCE.			REMARKS.
		Tons.	Cwt.	Ozs.	Dwt.	Grs.	
No. 27	680 to 682, 650 to 652, block 3.	1003	2	2583	6	6	
41	711 to 713, 742 to 744, block 3.	197	0	301	7	6	
47	653 to 655, 683 to 685, block 4.	511	18	768	18	5	
116	641 to 643, 672 and 673, block 3.	94	6	650	0	0	
No lease.	658 to 661, block 3.	9	0	9	2	7	
103	677 to 679, 647 to 649, block 3.	67	13	50	5	2	
155	schedule A.	28	9	24	11	10	
100	668 to 670, 637 to 639, block 3.	1	14	0	10	0	
123	see table for 1865.	312	16	604	10	18	
158	{ 711 to 713, 742 to 744, block 3.	{ 7	0	13	5	0	
168	{ 707 and 738, block 3.	{ 49	12	146	10	0	
74	745 to 747, 714 to 716, block 3.	65	10	51	17	13	
No lease.	626 and 657, block 3.	5	0	6	3	4	
"	616, block 3.	4	10	4	4	21	
"	640 to 642, block 4.	4	0	2	0	0	
164	663 to 665, 693 to 695, block 4.	3	15	0	11	13	
No lease.	687 to 689, block 3.	12	2	6	1	6	
		6	0	0	15	0	
		2383	7	5223	19	15	

164	663 to 665, 693 to 695, block 4.....	12	2	6	1	6
No lease.	687 to 689, block 3.....	6	0	0	15	0
		2383	7	5223	19	15

Statement of Quartz raised and Gold obtained from the Sherbrooke Gold District during the year 1867, as shown by the Quarterly Returns for that year.

No. of Leases.	No. of Areas.	QUARTZ CRUSHED.		GOLD PRODUCE.			REMARKS.
		Tons.	Cwts.	Ozs.	Dwts.	Grs.	
No. 100	668 to 670, 637 to 639, block 3.....	17	0	7	12	0	
177	schedule A.....	887	18	1296	12	20	
176	644 to 646, 674 to 676, block 3.	28	0	27	14	12	
181	680 to 682, 650 to 652, block 3.....	1521	10	2396	14	0	
116	641 to 643, 672 and 673, block 3.....	367	10	738	9	16	
123	see table for 1865.....	203	0	205	1	6	
171 & 175	schedule A.....	2275	0	2657	5	9	
196	".....	14	14	2	9	16	
No lease.	648, 649, 678, 679, block 4.....	19	8	3	16	7	
47	683 to 685, 653 to 655, block 4.....	96	15	22	6	0	
207	640 to 643, 671 to 673, block 3.....	353	18	509	2	20	
270	see schedule A.....	875	15	687	3	22	
290	".....	126	10	394	15	6	
197	776, 809, 810, 811, 840 to 843, 874, block 3	349	0	410	11	0	
No lease.	695, 723 to 726, block 2.....	2	10	1	7	0	
"	524, 525, block 4.....	8	15	7	5	0	
"	781, block 3.....	2	0	1	15	0	
155	see schedule A.....	3	18	10	3	0	
No lease.	637, block 4.....	14	5	4	3	17	
		7107	6	9384	8	7	

Statement of Quartz raised and Gold obtained from Sherbrooke Gold District during the year 1863, as shown by the Quarterly Returns for that year.

No. of Lease.	No. of Areas.	QUARTZ CRUSHED.			GOLD PRODUCE.			REMARKS.
		Tons.	Cwts.	Ozs.	Dwts.	Grs.		
No. 177	Schedule B.....	863	0	574	16	3		
270	".....	2436	5	1210	12	22		
293	672, block 4.....	0	12	1	13	3		
290	714, 715, 745, 746 E. $\frac{1}{2}$ 777 to 780, block 3	807	0	464	5	20		
No lease.	673, block 4.....	0	7	0	13	9		
181	680 to 682, 659 to 652, block 3.....	2640	10	2678	2	8		
316	653 to 655, 683 to 685, block 3.....	171	12	84	11	7		
197	776, 809 to 811, 840 to 843, 874 block 3....	364	0	447	3	8		
297	640 to 643, 671 to 673, block 3.....	852	7	411	0	6		
310	{ 643 to 647, 674 to 677, 672, 673, 702 to } 703, block 4.....	24	3	6	0	0		
No lease.	547, block 77.....	4	0	3	16	0		
306 & 307	Schedule B.....	75	0	29	0	0		
337	763, block 3.....	22	0	1	2	19		
351	704 to 706, 735 to 737, 764 to 767, and } 799, block 3.....							
349	707, 708, 738, 739, 768, 769, 800 and 801 } block 3.....							
356	770, 771, block 3.....	30	15	7	1	1		

{ 323 to 325, 331 to 344..... }

349	101, 708, 738, 739, 768, 769, 800 and 801 block 3.....	30	15	7	1	1
356	770, 771, block 3.....					

No lease.	{ 323 to 325, 331 to 344..... (The above are the number of leases and will be found in schedule B.)	24	11	2	15	10
198	N. W. 30-33 of 776, block 3.....					
199	West half of 777	543	0	507	1	0
290	714 to 715, 766, E. half 777 to 780, blk 3 { Schedule B.					
No lease.	{ Marked Z.....	57	0	12	5	6
"	919 to 922, block 2.....	21	0	1	10	10
"	629 and 630, block 2.....	1	0	0	13	22
		1	10	0	6	6
		8839	12	6404	10	16

*Statement of the Quartz raised and Gold obtained from the Sherbrooke Gold District during the year 1869,
as shown by the Quarterly Returns for that year.*

No. of Lease.	No. of Area.	QUARTZ CRUSHED.			GOLD PRODUCE.			REMARKS.
		Tons.	Cwt.	Ozs.	Dwt.	Grs.		
No. 270 (266) (267) (269) 207 348 316 209 100 176 306 290 197 181	Contains leases 266, 267 and 269 711 to 713, 742 to 744, block 3. 802 to 805, 831 to 836, 859 to 864, 887 to 889, block 3. 717, 748, block 3. 640 to 643, 671 to 673, block 3. 647 to 649, 677 to 679, block 3. 653 to 655, 683 to 685, block 3. 772 to 775, block 3. 668 to 670, 637 to 639, block 3. 644 to 646, 674 to 676, block 3. 795 to 798, 827 to 830, 858, block 3. 353 and 354, schedule B. 776, 809 to 811, 840 to 843, 874, block 3. 680 to 682, 650 to 652, block 3.	2086	12	594	15	12	{ About 500 tons of slate in this amount of Quartz.	
No lease. 328 314 and 322	Schedule B, marked W. 640, 641 and 642, block 4. 666, 667 and 668 block 4. Schedule B.	66 42 159 2 12 185 322 2997 110 1790	8 15 15 10 2 10 0 0 10 10	65 36 107 1 35 176 169 1091 39 1075	7 7 7 5 7 12 17 18 9 5	2 9 0 18 5 19 9 0 11 23		15½ tons slate.
							15 tons slate & 9 earth.	

SCHEDULE A.

No. of Lease.	Number of Areas.
No. 141	Areas 559, 574 to 589, 604 to 611, 618 to 621, block 3
(155)	Includes leases 151, 152, 153, 154.
(151)	715, 716, 717, 718, 720, 685, 686, 687, 688, 689, 690 and 719, block 4.
(152)	705, 706, 707, 708, 709, block 4.
(153)	777, 778, 779, 780, block 3.
(154)	521, 498, 582, 583, 584, 585, 586, 587, 558, 552, 553, 554, 555, 556, 557, 558, 493, 528, block 4.
177	559, 574, 575, 576, 577, 578, 579, 580, 621, 581, 582, 583, 584, 585, 586, 587, 588, 589, 620, 604, 605, 606, 607, 608, 609, 610, 611, 617, 618, 619, block 3.
171	802, 803, 804, 805, 831, 832, 833, 834, 835, 836, 859, 860, 861, 862, 863, 864, 887, 888, 889, block 3.
175	711, 712, 713, 742, 743, 744, block 3.
196	Includes leases 193, 194, 195.
(193)	708, 739, block 3.
(194)	887, 888, 889, 890, 891, block 2.
(195)	704, 705, 706, 735, 736, 737, 764, 765, 766, 767, 768, 769, 799, 800, 801, block 3.
270	Includes leases 266, 267, 269.
(266)	711, 712, 713, 742, 743, 744, block 3.
(267)	802, 803, 804, 805, 831, 832, 833, 834, 835, 836, 859, 860, 861, 862, 863, 864, 887, 888, 889, block 3.
(269)	717 and 748, block 3.
290	714, 715, 745, 746, E. half 777, 778, 779 and 780, block 3.

SCHEDULE B.

No. of Lease.	No. of Areas.
No. 177	30 Areas—559, 574 to 580 to 589, 604 to 611, 617 to 621, block 3.
270	Contains leases 266, 267, and 269.
(266)	711, 712, 713, 742, 743, 744, block 3.
(267)	802 to 805, 831 to 836, 859 to 864, 887 to 889, block 3.
(269)	717, 748, block 3.
306	795, 796, 797, 798, 827, 828, 829, 830, 858, block 3.
307	690 to 691, 719 to 722, 751 to 753, block 3; 721 to 726, 752 to 757, 784 to 788, 813 to 818, 661, 691 and 692, block 4.
323	669, 670, 671, 699, block 4.
324	704, 734, 735, 736, 765, 766, 767, block 4.
325	615, 616, and 617, block 4.
331	700, block 4.
344	701, block 4.
Z.	568 to 570, 599, 600, 629 and 630, block 3.
	Easterly parts of areas No. 714 and 748, block 3.
	718, 749, 781 to 785, 812 to 817, 844, 875, block 3.
290	714 to 715, 745, 746, E. half 777 to 780, block 3.
353	30x33 in N. W. corner of 776, block 3.
354	half 777, block 3.
W.	601 to 606, 631 to 636, 662 to 665, 693 to 695, block 4.
322	696 to 698, 727 to 730, 758 to 761, 789 to 794, 819, to 824, 849 to 854, block 4.
349	707, 708, 738, 739, 768, 769, 800 and 801 block 3.
378	27 to 37, 74 to 86, 128 to 133, block 11.

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ABSTRACT OF A PAPER ON GOLD-MINING AND ITS PROSPECTS IN NOVA SCOTIA: Embodying the results of Geological Surveys of the Districts of Waverley and Sherbrooke, for the Provincial Government. By HENRY YOULE HIND, M.A.

A paper read before the Society of Arts, May 25th, 1870; Warrington W. Smyth, Esq., F.R.S., in the Chair.*

(Reprinted for gratuitous distribution from the *Journal of the Society of Arts*, May 27th, 1870, by JAMES TENNANT, F.R.G.S., Mineralogist to Her Majesty, Professor of Mineralogy in King's College, &c., 149 Strand, W.C.)

I. General Description of the Relations of the Gold-bearing Rocks.

The area occupied by the lower Silurian gold-bearing rocks of Nova Scotia has been variously estimated at from 6,000 to 7,000 square miles.† Since these estimates were made, there has been described a series of gneissic rocks, supposed to be the equivalents of the Cambrian and Laurentian,‡ which occupy at least one-half of the area hitherto assigned to the lower Silurian. These rocks are not yet known to be auriferous, although from the discovery of an auriferous band in the lower Laurentian, in Ontario, beneath the great iron deposits.§ there is good reason for the expectation that an auriferous zone will be found in the Nova Scotian gneisses underlying the present gold-bearing series.

I do not suppose that the lower Silurian gold-bearing rocks of Nova Scotia cover a larger area than 3,000 square miles. Gold has been found also in the upper Silurian, which may be exposed over an area of from 500 to 800 square miles, so that the total known area of the gold-bearing rocks of Silurian age probably does not exceed 4,000 square miles.

There is, however, another remarkable source of gold in the conglomerates at the base of the lower carboniferous rocks. It is not surprising that gold should have been dis-

*The paper was illustrated by specimens kindly lent by Professor Tennant, consisting of a large number of gold specimens in the matrix from Nova Scotia, Canada, British Columbia, Australia, the West Coast of South America, North Wales, Cornwall, Scotland, and other localities, also some crystals of gold figured in Mawe's "Travels in Brazil."

†The total area of the gold region may be estimated at about 7,000 square miles, and the proclaimed districts do not yet reach a twentieth part of this area.—Dawson, "Acadian Geology," second edition, p. 632.

‡"Preliminary Report on a Gneissoid Series, underlying the Gold-bearing Rocks of Nova Scotia." By the author.

§Summary Report of Progress in Geological Investigations. "Geological Survey of Canada, 1869."

covered resting in the form of worn particles on the Silurian slates which support the oldest of the lower carboniferous conglomerates, or in the lower beds of the oldest conglomerate itself; but it is remarkable that gold should be found near the summit of a bed of conglomerate whose thickness is about 600 ft., and which is separated from the oldest conglomerate of the lower carboniferous series in Nova Scotia by an immense mass of bituminous shales and sandstones. In Cape Breton, gold has been discovered at the summit of a conglomerate occupying this horizon on the peninsula opposite Baddeck.

The occurrence of gold in the carboniferous conglomerates of Nova Scotia, especially at the base of the series, and in the fissures and crevices of the Silurian slates on which they rest, is highly important and suggestive, but too little is known respecting its distribution to make it a subject for description or discussion in this paper. During the ensuing summer its relations will probably be studied with some detail.

The lower Silurian rocks appear to be distributed chiefly on the south-eastern flank of a great gneissoid axis, which extends with some interruptions, hereafter noticed, from Cape Sable to the Gut of Canso, or, throughout the entire length of Nova Scotia. The most important break in the continuity of the gneissoid axis is a profound Silurian valley, averaging twelve miles in breadth, and extending from the Atlantic, at Halifax, to within ten miles of Windsor, near the Basin of Minas (Bay of Fundy). West of this Silurian valley, the gneissoid rocks occur in detached areas of greater or less extent, to the Gut of Canso. The most important at present of these gneissic areas is situated in the county of Guysborough.

In the Silurian valley between Halifax and Windsor, the gold districts of Lawrencetown, Montague, Waverley, and Renfrew are situated on the east side of the valley; Mount Uniacke and Hammond Plains on the west side. Around the gneissic nucleus in the county of Guysborough, the districts of Sherbrooke, Wine Harbor, Isaac's Harbor, Country Harbor and Cochran's-hill, are symmetrically arranged. The other districts, such as Tangier, Musquodoboit, Oldham, and Fifteen Mile Stream, bear also a certain relation to gneissic areas, but enough is not known of this relation to admit of description.

The Cambrian gneiss occurs about two and a half miles to the east of the worked lodes at Waverley, and about the same distance east from Goldenville at Sherbrooke. At Mount Uniacke it is about the same distance to the west. Most of the known gold districts occur in close proximity to gneissic areas, but this arises from the circumstance that denudation has been most active on the more elevated intersections of the anticlinals,

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and has removed the Silurian strata, thus exposing the underlying gneiss. When comparatively low anticlinals intersect, there is no gneissic exposure. Two sets of main anticlinals intersect one another in Nova Scotia, one set having an easterly and westerly direction, the other at nearly right angles, or a northerly and southerly course. At the intersections of these anticlinals the gold districts are situated, and here, also, where denudation has removed the Silurian strata, the underlying gneisses are exposed, or have been brought to the surface by the great dislocations which accompanied the last, or north and south folding.*

The districts of Waverley and Sherbrooke have been carefully surveyed, and their geological structure worked out with considerable detail. I was engaged in this duty during part of the autumn of 1868 and the summer of 1869, for the Department of Mines, and the maps which illustrate this paper are those which I prepared for the Department, and which, by permission of the Chief Commissioner, I have brought with me.

Waverley and Sherbrooke are types of all the known gold districts in Nova Scotia. One (Waverley) occurs with several others in a Silurian valley between two great exposures of gneissic rocks, the other (Sherbrooke) is one of many arranged round an island of gneiss.

II.—*Origin of the Gold.*

The results of my surveys do not show any direct relation between the origin of the gold and the gneissic areas. I consider that all the evidence hitherto accumulated in Nova Scotia tends to show that the gold was originally deposited from oceanic waters, and diffused throughout their sediments, especially in beds of quartz. Much of it was, no doubt, subsequently concentrated in intercalated beds of quartz, and some instances in fissure veins.

There is no evidence to show that intrusive rocks, or veins, or dykes had any share in the introduction of the gold; indeed, I have not yet seen any rocks in Nova Scotia, near the gold districts, which, upon close examination and study, can be regarded as intrusive rocks. Gold is found and worked in beds of quartz of contemporaneous age with the interstratified slates and quartzites, and in thin beds of slate adjacent to beds of quartz, throughout a vertical thickness of 6000 ft. These beds are worked in one district or another throughout that thickness of strata on anticlinal or synclinal folds.

*For a description of the structure of the gold districts, see reports on Waverley and Sherbrooke.

Waverley and Sherbrooke districts are eighty miles apart in an air line, and yet so uniform is the mineral composition of the series, that certain beds of grit can be identified at these distances, not only by the occurrence of peculiar forms, supposed to be an *Eospongia*, but by their mineral characters.

It must not be supposed, however, that all the worked auriferous lodes of Nova Scotia are contemporaneous beds. I conceive that a large number are intercalated, as subsequently described, and of the contemporaneous auriferous beds many have suffered much modification since first deposited.

III.—*Structure of Waverley Gold district.**

The strata at Waverley† are arranged in the form of a long elliptical dome, tilted over to the north. This form was occasioned by the intersection of two great anticlinal folds, one having a course from east to west, the other from north to south. The east and west fold has a slight overturn to the north. At Mount Uniacke the east and west fold has an overturn to the south, which is also the case at Sherbrooke.

The thin contemporaneous beds of auriferous quartz, or lodes, necessarily partook of all the movements to which the strata with which they are associated were subjected; hence, we find the outcrops of the lodes curving round the axis of the tilted east and west anticlinal in the form of long semi-ellipses, where denudation has exposed the edges of the beds. This distribution of the outcrop of the lodes is of the first importance, and it may be easily illustrated by bending a number of sheets of paper in the form of an arch, to represent the east and west anticlinal, tilting up one extremity to represent one side of the north and south anticlinal, and then cutting off a portion horizontally, to represent the effects of denudation. The exposed edges of the paper will then have the form of long semi-ellipses. It is evident that the outcrop of the lodes will be dependent upon the nature of the intersecting anticlinals, and the extent of denudation to which they have been subjected. Anyone familiar with the forms produced by the intersection of plain and curved surfaces, will readily understand how the mapping of the outcrop of these bedded lodes becomes a question belonging to stratigraphical geology.

In the autumn of 1868, the accompanying map of the Waverley district was prepared, and a lithographed reduction accompanies my report on that district. One of the most important lodes there is the Tudor lode, which was "lost," so to

*The details of the structure of this district are given in my "Report on the Waverley Gold District," Halifax, N. S., 1869.

†Waverley gold district is thirteen miles from Halifax, on the line of railway from H. x to Windsor.

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speak, at the point where the continuous line ceases on the map. This lode had yielded 8,727 ounces of gold from 6,972 tons of quartz, in 1865, averaging 1 oz. and 6 dwts. per ton. From a study of the structure of the district, the details of which are given in my official report, I indicated the course of the "lost" Tudor, as represented by the dotted line on the plan. Operations were commenced, late in the autumn of 1868, to discover this lode on the south side of the anticlinal, about 770 feet from the place where its alleged disappearance had occurred. In January, 1870, it had been traced, and in part worked back to the area where it had been "lost," through a distance on the curve of about 1,100 feet, connection with the original lode being broken by a small fault. The mean difference between the ascertained outcrop and the theoretical outcrop is 25 feet 9 inches in 1,100 feet horizontally.

The north lode is also a valuable lode at Waverley. This lode runs parallel to the Tudor on the north side of the anticlinal, and it has also been recently traced, and in part worked, parallel to the Tudor lode on the south side of the anticlinal, through a horizontal distance of 900 feet, the mean difference between the theoretical outcrop and the actual outcrop discovered being 25 feet 7 inches. The rocks throughout these distances of 1,100 and 900 feet are deeply covered with boulder drift, and of uneven surface, so that I may reasonably claim a closer approximation between theory and fact than a mean difference in outcrop of 25 feet 8 inches over a horizontal space of 2,000 feet.*

The geological structure of the Waverley gold district being the type of the structure of most of the other known districts, the importance of ascertaining the correctness of the views I had expressed respecting the origin, distribution, and general course of the lodes, and the laws to which they were subjected, acquired some interest, for, if generally true, some mining operations would be much facilitated in a country sometimes deeply covered with drift clays and gravels. Hence I quote, with much satisfaction, the following testimony from the Chief Commissioner of Mines, taken from his official report for the year 1869, p. 9:—(See page 23.)

The so-called barrel quartz, at Waverley, is a fair representation of a corrugated lode occurring on the crown of an anticlinal. In nearly all the gold districts the same form of quartz beds may be seen, and in similar relative positions. The corrugated structure is not confined to the quartz, but spreads fan-like into the overlying rocks, and appears to be in part the result of unequal pressure during the folding of the strata.

*For details, see letters entitled "Theory and Practice at Waverley," appended to a "Preliminary Report on a Gneissoid Series, underlying the Gold-bearing Rocks of Nova Scotia,"

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The foregoing observations apply to the old contemporaneous beds of auriferous quartz; but there is another class of lodes which have generally a bedded structure, but are of subsequent origin, and may be styled intercalated beds. These will be noticed in subsequent paragraphs.

In every district in Nova Scotia, it is remarked that the gold frequently "runs in streaks," that is to say a zone of rich auriferous quartz occupies a certain breadth in the lode, while to the east and west of that zone the quartz is comparatively poor in the precious metal. It is also found in different districts that the "gold streak" has a different angle with the horizon, and that sometimes the course of the rich zone corresponds, or is coincident with the ripples or swells in the lodes, and also that the gold streak varies in direction in different leads.

The position and dip of the gold streak being found on one side of the anticlinal, it can be traced to corresponding lodes on the other side, with such variations in dip as agree with the section of the curve of the anticlinal.

The term "gold streak," in Nova Scotia, is synonymous with the term "chimneys," in California, and "pipes," in Australia.

IV.—*Structure of Sherbrooke Gold District.**

If a slightly undulating line be drawn on a course S. 83° West (true), or N. 75° W. magnetic, from area 775, on the east side of the St. Mary's River, it will represent part of the axis of the Sherbrooke anticlinal. On the north side of the axis, the lodes dip to the north, at an angle generally about 45 degrees, except when approaching the axis, where they commence to curve. On the south side, the dip varies from 80 degrees to vertical, except when making the curve. Proceeding south from the axis, the lodes become more persistently vertical, until they acquire a slight northerly dip, thus showing that the form of the anticlinal is that of a slight overturn to the south, as represented in the sections. On making the curve, some of the lodes sweep gradually round with a dip, varying from 80 degrees south to 60° S.W., 35° S.W. by W., 26° W., then gradually increasing until they acquire the normal dip on the north side of the anticlinal, of about 45 degrees north. The plan of the Root-hog lode shows this curvature with some degree of detail. The strata and contemporaneous lodes at Sherbrooke, like those at Waverley, may be described as beds of slate and quartzite with thin sheets of auriferous quartz folded in an overturn anticlinal form, and subsequently

*The gold district of Sherbrooke is situated about twelve miles from the mouth of St. Mary's River, in the county of Guysborough. It is eighty miles east of Halifax in an air line.

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tilted to the east by a cross anticlinal. The denuded crest of the intersection of the anticlinals has exposed the sheets of quartz in the form of long semi-ellipses, whose bases rest upon Cambrian gneiss, from which the Silurian quartzites and slates have been removed by denudation. Numerous dislocations, having generally a north and south course, occur at Sherbrooke. These appear, like those at Waverley,* to have taken place during the north and south folding; some of them are represented on the plans and in the sections.

V.—*The Auriferous Lodes.*

As much misapprehension might arise from the broad statement that all the auriferous lodes in Nova Scotia are sheets of quartz, generally traceable from one side of a tilted anticlinal to the other side, in unbroken continuity, it is necessary to state distinctly that, although the sections exhibit this relation, yet it holds good only with reference to certain lodes which have been so traced, and to groups of lodes. This arises from the structure of the lodes. (See page 20 to 25.)

* * * * *

VI.—*Mining Economies in Nova Scotia.*

I propose now to glance briefly at the condition of mining in Nova Scotia, and then to furnish some facts from official returns, which will enable a correct appreciation of the gold wealth of the Nova Scotian lodes to be formed.

From the most reliable information accessible, it appears that there are now seventy companies or associations engaged, actually or nominally, in gold mining in Nova Scotia:—

No. of Companies,	Where organised,	Estimated cost and actual working capital.
16	Montreal	480,000 dols.
6	Toronto	240,000 "
7	Kingston	210,000 "
2	New York	250,000 "
10	Boston	500,000 "
2	St. John, N. B.	50,000 "
12	Halifax, N. S.	134,000 "
3	United States	60,000 "
3	Ontario	60,000 "
3	Nova Scotia	10,000 "
1	Liverpool, England	25,000 "
2	London, do.	85,000 "
6	Private	20,000 "

*For a description of the dislocations at Waverley see report on that district.

Some of these are of a purely speculative character, some have ceased working, others are profitably carrying on the business, but, as shown in succeeding paragraphs, in a very unscientific and wasteful manner. A few are working with comparative economy, but no approach is made to the admirable system which frequently obtains in Victoria, where that best of mining schools, experience, has taught miners to conduct gold mining with the same attention to detail as is thought absolutely essential to success in any other branch of industry.

In very many cases, mismanagement has been the cause of the suspension of works, which, with ordinary care in the hands of an experienced agent, would have proved successful.

Local companies have been often formed in the following manner:—A prospector finds a lode showing numerous specks of gold at the surface. Three or four speculators join together and form a company, purchasing the property for a nominal sum, and a considerable portion of so-called paid-up stock. They put the capital at 100,000 dollars (100,000 shares at one dollar a share). The shares are sold at two cents and upwards. With the money thus obtained, work is commenced, and if the quartz continues promising, enough capital is raised to erect a mill, and there is a prospect that the speculation may turn out profitably; but if the auriferous character of the quartz diminishes, the collapse of the company becomes a mere question of time, for the shareholders almost invariably refuse to submit to a call.

The following tables show the average yield of gold from quartz in Nova Scotia and in Victoria (Australia):—

*Average Yield of Gold in Victoria from the year 1859 to 1868 inclusive.**

Year.	Quantity crushed.		Total produce.		Average yield per ton.		
	tons.	cwts.	oz.	dwt.	oz.	dwt.	grs.
1859	39,034	0	47,524	14	1	4	8.4
1860	86,594	16	81,905	2	0	18	22
1861	350,409	0	299,482	13	0	17	2
1862	567,208	0	310,725	4	0	10	22
1863	523,226	0	323,190	14	0	12	8.5
1864	843,515	10	433,981	16	0	10	6.9
1865	705,134	0	419,325	3	0	11	21.4
1866	861,468	13	459,895	7	0	10	16.2
1867	948,850	12	498,677	12	0	10	12.2
1868	886,228	18	47,493	3	0	10	15.37
Totals....	5,811,669	9	3,346,201	8	0	11	12.37

*"The Gold Fields of Australia." By R. Brough Smyth, F.G.S.

Statement showing the number of tons of Quartz crushed, the yield of Gold, and the average yield per ton, in the Province of Nova Scotia, during the years 1862 to 1869 inclusive.

Year.	Quartz crushed.	Yield of gold.			Yield per ton.		
	tons.	oz.	dwt.	grs.	oz.	dwt.	grs.
1862	6,727	6,799	0	0	1	0	5
1863	17,001	13,973	14	17	0	16	12
1864*	15,316	14,526	18	5	0	19	0
1865	23,835	24,725	22	22	1	0	21
1866	30,963	24,125	13	18	0	15	14
1867	30,673	27,534	4	14	0	17	23
1868	31,242	20,518	10	14	0	13	3
1869	35,424	17,690	2	8	0	10	2
Totals. . . .	191,181	149,894	7	2	0	15	16

From careful assays of numerous parcels of tailings in Nova Scotia, as they came from the mill, and selected indiscriminately, the average quantity of gold contained was found to exceed 4 dwts. per ton. In many instances the assay gave a very much larger yield. These tailings lie around the mills in every direction, or are allowed to run into the nearest stream; in no instance known to me are they concentrated, even to save the pyrites, or are any really valuable appliances used to save the free gold they contain, which has escaped from the stamping boxes or the amalgamating tables.

* * * * *

A year ago, attention having been called to the escaped gold in the tailings at one of the mills at Waverley, portions were re-crushed and passed over the amalgamating tables; and in the official returns for 1869 we find the following statements: 288 tons of waste from dump gave 32 oz. 5 dwts. 11 grains; 63 tons of waste from dump gave 13 oz. 12 dwt. 16 grains. From this experiment some idea may be formed of the amount of gold allowed to escape in the tailings from upwards of 190,000 tons of quartz, the quantity already crushed in Nova Scotia.†

VII.—Mining Economics at Waverley.

The mine which I shall select, as an illustration of gold mining at Waverley, is the one where part of the Tudor lode is

* Nine months.

† See also tables showing returns from Sherbrooke district for remarks on gold in the tailings.

worked. The following extracts from my official report in 1868, compared with what is now being done in 1870, will afford a fair example of the improvement of which Nova Scotia mining is susceptible:—The mill at this mine is driven by water; it has sixteen stamps; amalgamation takes place in the battery and on tables; no blankets are used, or concentrating apparatus of any kind to save the pyrites or free gold which have escaped amalgamation; the tailings flow into the stream and are lost. In the year 1865, 6,972 tons of quartz were crushed and treated in the manner described. The yield of gold amounted to 8,727 ounces, or 1 oz. 6 dwts. 12 grains per ton. The total cost of getting the gold, up to the close of 1866, averaged 12 dwts. (12 dollars) a ton. In 1867, the works were carried on with greater economy, and the lode, at a depth of 300 feet, averaged 15 inches in thickness, and yielded (not including the tailings) 8 dwts. a ton, and was worked with a small profit. When the average yield fell to 7 dwts. a ton, the works were stopped, on account of not paying expenses. This was the condition of the mine during my visit in the autumn of 1868.

* * * * *

Let these statements of facts in 1868 be contrasted with the following in March, 1870. My authority is one of the mine-owners at Waverley, to whom I applied for information respecting the progress of his works, in February of the present year. The mill and mine are the same as referred to in the preceding paragraphs:—

“I work at present four shafts on the south side, on tribute which leaves my men with a yield of 3 dwts. per ton on average, from 1 dol. to 1 dol. 50 c. clear wages for every working day, and to me something over 50 cents per ton. The difference between 1 dol. and 1 dol. 50 c. wages depends entirely upon the greater or smaller ability and industry of the miners, by which they will raise larger or smaller quantities of quartz per day, which, with such a small yield as 3 dwts. per ton is all important.

“My arrangement with the miners is, that they get for their labour and the expenses, except crushing and hauling, all the gold, and pay me for crushing and hauling 1 dol. 25c. per ton.

“The lode is from twelve to eighteen inches thick, and three men raise, on an average, from fifty to sixty odd tons of quartz per month. That the lode works extraordinarily easy is a matter of course; deducting the crushing and hauling, there remains not much more for the raising of the quartz than a little over 1 dol. 50c. per ton.

“In proof of my own profit of at least 50 cents per ton, you will find the following calculations:—I crush with eight

stampers, in twenty-four hours, at least 13 tons on the average, and for this work I employ two very experienced feeders, who have, at the same time, charge of the mill, and two breakers. Of the feeders, one receive 1 dol. 40 c., and the other, 1 dol. 35 c. a day; and of the breakers, one, 1 dol. 25 c., and the other, a boy, 1 dollar per day, that is altogether 5 dollars. This makes, with 13 tons, \$38.6 per ton. The whole expenses of wear and tear (in the main part stamper shoes) and loss of quicksilver, are under no circumstances higher than 15c. per ton, which would bring the crushing expenses up to \$53.6 per ton. The hauling costs 20c. per ton, and this shows that I make at least 50c. per ton clear.

"I think this is the first instance that a lode of this thickness has ever been worked with a profit, at a yield of 3 dwts.

"Quite different is it with the South Tudor lode, which works very hard, a great deal harder than ever the north dip worked. The two reasons of this are, first, that the south dip is so very much flatter than the north dip, and, second, that the small band of soft slate (goudge) which was nearly everywhere (with some interruptions) on the north dip, is nearly entirely wanting on the south dip, which makes the stripping of the lode a by far more difficult task. Nevertheless, I work the lode as cheap as I ever worked the north dip in the cheapest time; but the men have to work harder to make a living by it than they ever worked before. If it was not for the great scarcity of work, they scarcely would endure it long, particularly in this humid winter, where half their time is lost by water-pailing (hoisting water in buckets).

"I pay 10 dollars for sinking and 40 cents for stopeing, the men to find everything, which brings up the cost, crushing and hauling included, to about 9 dollars per ton. I am putting up now a gin and commence to sink down one shaft in advance of the others, preparatory to dispensing with all sinking except in the one shaft, which will always be the deepest point, and from which the lode is stoped out east and west in the form of terraces. I have no doubt that this arrangement will bring down the expenses to 8 dollars per ton, everything included. How long I shall be able to work without a pump I cannot say, but Lake Major Company has worked without it down to 300 feet, though I have at present by far more water than there was in this part of the north dip.

"My experience on the north dip has convinced me that, as long as the formation remains the same, the mining expenses do not increase, down to at least 300 feet, and I am sure a good deal further, except in expenses of the pump. Where there is a pump, a horse gin will raise from two shafts all the quartz that can be mined, just as well from 300 feet depth as

from 100 feet. I do not save the pyrites yet, because I have not yet put up a German buddle."

The system of mining generally adopted in Nova Scotia greatly increases the expenses of raising the quartz.

On the plan of Waverley the positions are marked of the shafts on part of the Tudor and north lodes.

The north lode and the Tudor lode are, on an average, 60 feet apart at the outcrops, their dips being nearly the same. The number of shafts sunk by different companies on these lodes, within a mean distance of 2,000 feet, is 54, having a mean depth of 200 feet. This is equivalent to a shaft to every superficial area of 47 feet square.

* * * * *

The reasons why failure and collapse, in place of continued prosperity, have characterised some mining properties in Waverley, and indeed throughout Nova Scotia, I have already officially stated to be as follows* :—

1. The absorption of all returns to pay large dividends.
2. The small size of some of the properties.
3. Insufficient working capital at the outset.
4. A uniform neglect in preserving records and plans in detail of the works.
5. Inadequate machinery and appliances to save gold.
6. The want of labour-saving machinery.
7. Ignorance respecting mining operations, the "gold streak," or "chimneys," or "pipes," or zone of auriferous quartz.
8. General neglect of the contract and tribute system.
9. And, as a necessary result of the foregoing, the frequent incompetency of some of the so-called managers.

VIII.—*Mining Statistics.*

The following tables have been kindly supplied by the Commissioner of Mines at Halifax, and they have all the seal of the office attached to them. A glance at these tables will show that the gold yield from quartz of some of the Nova Scotian districts is in excess of the average of gold mining countries generally. Tables are also given of the yield of certain mines in each district, from which some ideas may be formed of the productiveness of the quartz, and of the extent to which the returns might be increased if the same economy in mining, skill in manipulation, and eagerness to adopt improvements existed in Nova Scotia which are now common in Australia and California. The decrease in the general annual average at Sherbrooke is due to the cessation of the process

* *Vide* report on the Waverley Gold District.

of culling the quartz, which was to a large extent common in the infancy of mining in Nova Scotia. At the present time, not only is the quartz of the lode crushed, but also some inches of the adjoining slate, and at Musquodoboit and Isaac's Harbour, broad bands, from 14 to 20 feet of mixed slate and quartz, are crushed with returns shown in the tables :

SHERBROOKE GOLD DISTRICT.

Statement of Quartz crushed, and Gold obtained from the Sherbrooke Gold District, during the years 1863 to 1869 inclusive, together with the average and maximum yield of Gold per ton, as shown by the Quarterly Returns rendered the Department of Mines.

Year.	Quartz raised.	Gold obtained.			Average yield.			Maximum yield.		
	Tons.	Oz.	Dwts.	Gr.	Oz.	Dwts.	Gr.	Oz.	Dwts.	Gr.
1863	3,454	3,304	14	12	. . .			12	0	0
1864*	1,909	2,611	6	22	. . .			20	0	0
1865	2,637	3,137	9	5	. . .			8	3	0
1866	2,684	5,157	14	17	1	22	0	16	6	16
1867	5,809	8,522	8	11	1	9	8	11	13	5
3 mos. do.	2,376	2,708	8	18	1	2	19	5	0	0
1868	8,880	7,070	0	5	0	16	0	12	15	0
1869	11,500	5,546	11	16	0	9	15	6	9	13
Total.....	39,249	38,058	14	10	0	19	9	20	0	0

* Nine months to September 30.

In 1862 there was obtained 2,023 ounces, as near as could be ascertained.

Statement of labour performed on areas 650, 651, 652, 680, 681 682, block 3, Sherbrooke District, the property of the Wellington Gold Mining Company, during the years 1863 to 1869 inclusive, and results.

Days.	Date.	Quartz crushed,		Yield of Gold,		
		tons.	cwts.	oz.	dwt.	grs.
1,800	1863. Dec. 31....	149	16	222	15	2
500	1864. Mar. 31....	32	15	95	10	22
300	June 30....	40	4	71	5	5
780	Sept. 30....	16	1	39	12	2
666	Dec. 31....	13	0	27	10	12
459	1865. Mar. 31....	18	19	13	11	16
710	June 30....	109	0	107	17	19
737	Sept. 30....	107	0	428	15	0
1,297	Dec. 31....	285	18	766	15	2
1,400	1866. Mar. 31....	219	10	298	0	12
1,244	June 30....	409	14	991	6	3
700	Sept. 30....	389	0	871	18	22
1,650	Dec. 31....	266	18	864	4	15
3,000	1867. Mar. 31....	400	0	940	0	0
3,004	June 30....	465	0	634	6	0
2,800	Sept. 30....	335	10	314	14	0
2,000	Dec. 31....	312	10	507	0	0
3,600	1868. Mar. 31....	596	10	1,061	18	6
4,600	June 30....	550	16	456	11	16
3,510	Sept. 30....	844	12	644	5	0
3,500	Dec. 31....	448	12	515	11	10
4,000	1869. Mar. 31....	682	0	600	0	12
4,000	June 30....	1,059	0	794	3	5
3,244	Sept. 30....	731	10	281	2	18
3,800	Dec. 31....	500	17	666	17	0
53,301	.....	8,984	12	12,215	13	7

RENFREW DISTRICT.

Table shewing the date, tons of Quartz crushed, and Gold obtained from the Ophir Mine, in Renfrew District, County of Hants.

Date.		Tons.	Cwts.	Oz.	Dwts.	Grs.
1866.	Sept. 30.....	677	0	1,000	10	0
	Dec. 31.....	1,208	0	2,142	4	0
1867.	March 31.....	1,395	0	1,885	15	0
	June 30.....	1,503	0	1,674	0	0
	Sept. 30.....	1,656	0	1,587	5	0
	Dec. 31.....	946	15	907	0	0
1868.	March 31.....	704	0	571	10	0
	June 30.....	1,317	0	736	3	0
	Sept. 30.....	1,385	0	706	15	0
	Dec. 31.....	2,029	0	1,046	10	0
1869.	March 31.....	1,562	0	724	18	0
	June 30.....	1,285	0	612	10	0
	Sept. 30.....	850	0	302	0	0
	Dec. 31.....	1,915	0	571	10	10
Total		18,432	15	14,468	10	10

WAVERLEY DISTRICT.

Table showing the quantity of Quartz crushed, and amount of Gold obtained from the German Mines on the Tudor and North Lodes, Waverley District, County of Halifax.

Date.	Days' labour.	tons.	cwt.	one.	dwt.	grs.
1863. Dec. 31..	3,370	381	15	151	7	9
" " ..	338	47	9	33	18	12
1864. Mar. 31..	1,360	212	10	125	16	14
" " ..	3,083	263	0	134	5	14
" June 30..	1,700	162	15	132	8	3
" " ..	4,800	331	0	224	12	17
" " ..	2,550	40	0	30	0	0
" Sept. 30..	5,100	759	0	704	11	3
" " ..	2,300	294	0	317	12	0
" " ..	4,700	306	0	216	15	3
" Dec. 31..	5,000	757	0	608	5	5
" " ..	2,000	263	0	316	5	16
" " ..	4,900	278	0	228	15	12
1865. Mar. 31..	2,500	274	0	375	15	10
" " ..	1,800	218	0	491	3	0
" " ..	5,000	795	0	811	0	10
" June 30..	1,400	305	0	829	11	0
" " ..	4,100	1,049	0	1,253	2	2
" " ..	2,000	357	0	680	18	1
" Sept. 30..	1,700	443	0	772	19	7
" " ..	2,300	396	0	517	4	0
" " ..	4,000	1,352	0	1,226	12	21
" Dec. 31 ..	1,100	355	0	432	18	0
" " ..	1,300	250	0	225	3	0
" " ..	3,000	1,611	0	1,253	2	12
1866. Mar. 31..	1,400	350	0	188	3	0
" " ..	500	70	0	23	6	0
" " ..	3,000	1,210	0	609	1	0
" June 30..	6,080	1,500	0	995	0	0
" " ..	2,000	245	0	141	18	0
" Sept. 30..	2,300	293	0	235	9	15
" " ..	5,415	1,406	0	923	0	0
" Dec. 31..	1,800	248	0	172	15	0
" " ..	3,000	833	0	316	0	0
Total.....	96,896	17,655	9	15,698	15	18

STORMONT DISTRICT (ISAAC'S HARROUR).

Table showing the quantity of Quartz crushed, and amount of Gold obtained from areas 12 and 13, and other mines on the Mulgrave lode, Stormont district, Guysborough County.

Date.	Days.	tons.	oz.	dwt.	grs.	Remarks.
1863. Jan. 30...	468	20	120	0	0	Area No. 12.* 150 ft. on lode. 250 ft. across.
Sept. 30...	780	55	119	0	0	
Dec. 31...	750	57	126	0	0	
1864. Mar. 30...	700	.....	.....	.....	.....	
Jan. 30...	1,026	160	368	0	22	
Sept. 30...	650	.....	.....	.....	.....	
Dec. 31...	720	90	210	6	4	Area No. 13.*
1865. Mar. 31...	900	42	95	18	0	
Jan. 30...	80	13	17	3	16	
Total.....	6,074	437	1,056	8	18	
1863. June 30...	416	22	145	0	0	Area No. 13.*
Sept. 30...	208	48	228	0	0	
1864. Mar. 31...	600	.....	.....	.....	.....	
June 30...	650	64	260	12	16	
Sept. 30...	250	42	97	7	18	
Dec. 31...	127	.....	.....	.....	.....	
1864. April 1...	52	8	1	13	6	Area No. 13.*
Total.....	2,403	184	722	13	16	

Other mines on shoot (see Report for 1868).

Date.	Days.	tons.	oz.	dwt.	grs.
1864		59	183	3	11
1865		535	924	8	12

*These areas were mined in 1862, but there was no regular system of return until May, 1863.

MUSQUODOBOIT.

Table showing the quantity of Quartz crushed, and amount of Gold obtained at the Bushing Mine, at Musquodoboit "Jennings" district, in the county of Halifax.

Date.					Remarks.
1869.	tons.	oz.	dwt.	grs.	
April.....	56	37	10	0	Area 19, 20, 21, 22 and 23. Large lode, about 20 ft. in thickness, composed of quartz and slate; about half quartz.
May.....	116	46	8	0	
June.....	158	53	10	0	
July.....	10	19	0	0	
".....	155	46	2	0	
August.....	190	51	0	0	
".....	5	9	0	0	
September.....	102	32	2	0	
October.....	94	26	9	0	
November.....	124	35	2	0	
December.....	7	12	15	0	
Total....	1,017	368	18	0	
April.....	10	8	10	0	Hyde lode; area 221 and 231; about 5 in. thickness.
June.....	34	28	5	0	
July.....	14	7	17	0	
September.....	7	1	18	0	
November.....	7	1	15	0	
Total.....	72	48	5	0	
August.....	22	71	0	0	Drunbrack lode. 15 in.; area 327.
September.....	23	31	17	0	
October.....	52	28	10	0	
Total.....	97	131	7	0	

HYDE'S MINE ON AREAS 221, 222, 223, 224.

1869.	tons.	oz.	dwt.	grs.	
October.....	92	142	11	0	
November.....	137	126	0	13	
December....	79	60	19	0	
1870.					
January.....	90	93	1	0	
Total.....	398	422	11	21	

DISCUSSION.

The CHAIRMAN, in inviting discussion, said he desired to point out that the paper divided the subject of gold mining into two important points, one being the question as to the occurrence of gold, for it must be known first whether there was a sufficient quantity of gold in the district to make it worth while for companies to subscribe capital, and expend money in a series of operations carried on for many years; and the second question referred to the method of, and economy in, extracting the gold. On the former question he should have something to say himself; and with regard to the latter, Professor Hind had gone pretty fully into it, pointing out nine distinct causes of failure which had come under his own notice. If any gentleman present had any experience in works of this kind it would be desirable that they should give additional information or confirmation of Mr. Hind's statements, particularly with regard to the stratification of auriferous quartz in Nova Scotia.

Mr. ROBINSON said he might venture to make one or two remarks on the method of mining adopted in Nova Scotia, having recently visited that country, and being acquainted with the progress of operations there. With reference to the theoretical part of the question, he might refer those interested in it to a paper which was read before the Geological Society, a short time previously, by Professor Hind, giving a very elaborate account of the structure of the province. Having visited Waverley with that gentleman, he could confirm generally what was stated with respect to the imperfect arrangements made for mining; in fact, it was not so much as tinkering or surface work, as was shown by the fact that for a lode 1,500 feet in length 54 shafts were sunk to extract quartz. As to the arrangements of the strata also, he quite agreed with what had been stated, and in one district with which he had most to do, Lawrencetown, the strata was proved to be a synclinal fold. In fact, after working there for six months, the result showed that the form of the lode was as nearly as possible exactly what was predicted in the first investigation of the district. With regard to Waverley, the lode there was lost by reason of a fault, and when he visited the place with Professor Hind, in 1868, its position was of great importance, inasmuch as the whole settlement was at a standstill for want of employment. Subsequently to his investigation it was again discovered, and operations were doubtless now in full swing again. One of the districts, not specially alluded to in the paper, Montague, was very remarkable for the very large yield which had been found from the

commencement, the returns of the Chief Gold Commissioner showing that, for a series of years, there had been a yield of 1 oz. 5 dwts. per ton, which was the highest on record. The tailings there had also been assayed, when it appeared that 13 dwts. per ton were being thrown away. Those acquainted with gold mining knew that in a well managed mine, with good mill-power and proper machinery, the cost of getting did not exceed 4 dwts. to 5 dwts., so that when they found that 13 dwts. were absolutely wasted, in addition to the 1½ oz. obtained, it was abundantly evident that the importance of Nova Scotia, as a gold field, could hardly be over-estimated. Oldham was another part which he visited, and there he found the yield of gold exceed 1 oz. per ton at some small workings which were now being considerably extended with the aid of English capital. In conclusion he thought Professor Hind was entitled to the thanks of the public for bringing this matter forward, for it was now evident that, with such a supply of gold in the nearest of England's dependencies, there was an enormous source of wealth only waiting the operation of English enterprise and capital. He held a decided opinion, which he had often expressed both in public and private, that Nova Scotia would be found to be one of the most important gold fields in the world when its resources were properly developed.

Mr. ARTHUR SOPWITH said that he had just returned from Nova Scotia, and he could to the utmost corroborate the statements made by Professor Hind, as to the manner in which mining was conducted there. One of the most important points in any large gold-producing country was the treatment of the tailings and arsenical pyrites, from which the gold was more difficult to separate than from any other metals with which it was found combined. It was not exactly within the scope of the paper, which treated principally of the other districts, but he might mention that in the Montague mine, which was one of the most interesting in the province, and was in the neighbourhood of Waverley, there were found in the foot wall of the lode masses of arsenical pyrites about the size of two fists joined together, at very short intervals, and this really amounted to a considerable portion of the lode, which was only two inches thick; but the persons working that mine were so ignorant of anything like the assaying of ores, that they were actually storing it, and proposing to send it over to Swansea, paying heavy freight to have it smelted there. It was very probable that this pyrites would give from £80 to £120 per ton, at any rate if the statements made were anything like correct, as it was in appearance exceedingly rich. With regard to the cost of mining, the Nova Scotian methods of working were very limited; but, on the other

hand, it must be remembered that unless sufficient capital were subscribed to carry on operations, for a long time it would not pay to erect good machinery and pumping gear, with barren ground. It was the case in all metalliferous mines, that a large proportion of barren ground had to be opened, and unless there were plenty of capital, a person might be ruined at once by setting up expensive machinery. The fact was, not a single mine in Nova Scotia had been started with anything like what would be considered in England a sufficient capital. That the lodes were in some parts exceeding auriferous might be gathered from this fact:—he had himself been down nearly 200 feet, working a lode of only four inches, which was worked a length of about 300 or 400 feet, which had necessarily required the taking away of a large part of the adjoining rock, but, nevertheless the work had been successful. Not only were there these position beds, for there could be no doubt they were true beds, also a great number of cross leads was the richest part of the lode. This was a point which required a good deal of attention, because if the cross lead were struck, it might cut through two or three lodes without being cut out, and at all points of intersection it might be very rich. By striking on a length of cross lead, and through the main leads, which, as a rule, lay pretty close together, the work would be found much more productive than trying here and there in a main lode, trusting to chance to get a nest of gold.

Dr. BOYCOTT said it appeared, after all, that what was wanted for working these mines was, not so much money as more information and skill. It seemed a great pity that these operations should be undertaken by such ignorant people, for it appeared pretty plain that many of the miners lacked the commonest information, which was now distributed pretty well all over the world, through the influence of the School of Mines in Jermyn street. He was, therefore, astonished to find that there was so much waste of money and labour still going on, and that some means were not adopted for securing information. The mere statement of such facts sufficed to show the necessity for education being extended in a greater measure to our colonies, and, if possible, he thought the government should send out inspectors to see that these mines were properly worked. He should like to know whether the Chairman's opinion coincided with that of Professor Hind as to the gold being deposited from sea water.

Mr. BOTLY said society at large must be indebted to Mr. Hind for the paper he had prepared, and particularly for calling attention to the nine causes which had produced failure and collapse in so many cases. Several of them, such as the absorption of the whole of the returns to pay large dividends, the smallness of the operations, the want of labour-saving

machinery, and the incompetency of some so-called managers had been fruitful sources of loss in England, particularly the last, and therefore he could well believe that no successful gold operations could be carried on while they continued to exist.

Mr. ROBINSON, in reference to what had fallen from Dr. Boycott, said that mining in Nova Scotia was of very recent date, and, of course as in the case of all other countries, they had to go through a sort of apprenticeship before much progress was made. There was an inspector of mines in Nova Scotia, who was well qualified to give every information, but he did not apprehend it came within his department to tell persons when they were spending their money foolishly.

The CHAIRMAN said that, as an old dabbler in gold mines in various parts, he could not help feeling much interested in the paper, following up as it did the accounts which had been received from other sources, with regard to a colony so near to the seaboard, and which appeared to offer so many inducements to the capitalists to embark in mining enterprise. There was nothing so pleasant as gold mining, if you could only get a sufficient yield, for there was no trouble whatever in disposing of the product, as was sometimes the case with large quantities of bulky produce. But on the other hand there were certain disadvantages, amongst the principal of which were the great uncertainty and the great proneness to accident amongst the veins which produced the gold. On this part of the subject he could not help saying that, although Mr. Hind had appeared to make good his statement as to the structure of this part of Nova Scotia, he could not help being still a little sceptical as the fact of gold being distributed so regularly throughout a series of beds of quartz. It was true, in the latter part of the paper, this statement was somewhat "hedged," and it was pointed out that there were irregularities, which one would have been scarcely induced to expect from the first account of what appeared to be regularly stratified beds. For himself, he could not help coupling what was said about synclinal and anticlinal beds as a certain amount of theory, and bringing it to bear upon the explanation which was suggested of these facts, viz., that the gold had been deposited contemporaneously with the quartz by the seawater. If this were so, why was not all the gold deposited at the bottom of the sediment, by reason of its greater specific gravity? But by another part of the paper it appeared that the gold ran only in streaks, and that it seemed to be accumulated near certain crossing of these beds by other lines of quartz, which looked more like true veins. At present, therefore, he could not help saying he thought there was a good deal more to be made out. He had on former occasions visited certain localities, though not in Nova Scotia, where it was said that minerals

occurred regularly throughout a stratified mass, but he had usually found such a statement to be the result of deficient observation. In a certain part of the stratified-looking mass there had been a dissemination of mineral matter, but very frequently this apparently stratified mass was nothing else but a mass of stratified material, ground and rubbed together, and existing between two walls resembling those of a regular vein; or again that the mineral matter had been most decidedly intercalated at a period long subsequent to the original formation of the beds. He could not help thinking, in spite of all the excellent accounts which had been brought forward, that this would prove to be the real explanation of the occurrence of the gold in a great part of these Nova Scotia deposits. With regard to the second part of the question, it appeared quite clear that there was, throughout a great part of this district, a sufficiently large portion of gold extending throughout these quartzose deposits, whether beds or veins, to pay well for mining enterprise, and the question might therefore be asked why had it not succeeded better? For a number of years, 600 or 800 men had been engaged in this work, but only a few mines had been successful, and therefore they were much indebted to Professor Hind for the valuable statistics he had brought forward, because the question seemed to be—Given that this was really a gold containing district, was it not possible, instead of these 600 or 800 men, to employ 6,000 or 8,000, or even more, in raising gold, to the advantage of all parties concerned? Undoubtedly it ought to be so, for there was no doubt that here there was a gold-field such as was seldom to be met with; and if the proportion laid down from the statistics furnished by the Commissioner of Mines were to be depended upon, there ought to be machinery and appliances brought to bear upon these mines, such as would ensure a very handsome return to capital invested in undertakings intended to last over a long series of years. This was really a point of almost imperial importance, for it appeared that, up to the present time, the resources of the country had been developed to a pitifully small extent and no doubt that this was because the undertakings had been conducted by persons unprovided with money, or with that intelligent guidance which it might be presumed they would have had if the matter had been taken in hand by persons better provided with money, without a good supply of which nothing could be successfully carried on. He could not help remembering, when mention was made of the large quantities of ore which had been stamped or crushed in order to extract the gold, that it was not above two-thirds of the quantity which one single tin mine in Cornwall was in the habit of stamping per annum by means of its efficient machinery, worked by steam or water-

power, for the purpose of extracting a small modicum of tin ore, and that showed that the work had not been undertaken upon such a scale as to render any great success probable. Again, he noticed that from the large quantities of ore raised in different places, the proportion of gold was from 1 oz. 1 oz. 4 dwt., or even 1 oz. 16 dwts. per ton, and that in the Waverley district it was found that a proportion of 7 dwts. per ton would not yield a profit. On the other hand in travelling through the Tyrol into Italy, a few miles from Innspruck, there was to be found a mine at Heinzenberg, at Zell in the Zillerthal, worked for gold only, a mine worked to a much greater depth than any in Nova Scotia (where the richer material would produce perhaps 10 dwts. to the ton), but where the proportion of gold present in the bulk of the ore was not more than about 2 dwts per ton. It would have been very interesting if there had been any gentleman present, conversant with the practical details of the process by which gold was extracted, to have heard a few words upon the actual contrivances employed in this case, but it would be almost foreign to the question brought forward in the paper, the principal object of which was to show, first, that gold existed in large quantities in Nova Scotia; and, secondly, that it afforded a field for the advantageous employment of capital from abroad. In spite of the nine causes of failure which had been mentioned, it was evident that many of them would disappear the moment that large capitalists were prepared to go into the matter, because if large companies were formed in England, they would of course employ agents familiar with the machinery and appliances requisite for successful mining, who would open workings upon a very different scale from anything which had yet been attempted. One point he might venture particularly to call attention to. A great deal of attention was given apparently, as had been well pointed out by Mr. Robinson, to the sinking of a great number of shafts. But any one familiar with mining operations must know, that sinking so many shafts in one lode, was like opening so many different mines at once, and exposed the company to such expense that it was extremely unlikely it could succeed. Again, it appeared that these shaftings and levels were mere little holes, as compared with what were called shafts in many old-established mining districts. They had been open for eight or nine years, but yet they still measured the depth only by 100 or 120 feet, or in some cases as much as 200 feet. In this country however, mines were accustomed to go by fathoms, or yards at least, and they would think very little of the depth of a shaft of 200 feet, when it came to be reduced to fathoms. Then, again, there was the question of opening the ground horizontally by drifts. It was very well known that even in copper, lead, or

tin veins in this country it was useless to exceed any great depth, until by perseverance, continued over several years, a large quantity of ground had been opened, for the purpose of passing through the different lodes, and discovering what were called pipes, shoots, or by various names in different localities. Until a work of this sort had been fairly accomplished, nobody could say that a mine, whether tin, silver, lead, or still less so in the case of gold, was worth working or not. He hoped the information which had been so well put together in the paper would lead to the establishment of a better state of things than had yet been the case in the colony, and, in conclusion, begged to propose a hearty vote of thanks to Professor Hind for the paper which he had read.

The vote of thanks was passed unanimously.

APPENDIX No. 1.

THEORY AND PRACTICE AT WAVERLEY.

Windsor, January 11th, 1870.

Hon. R. ROBERTSON, M. E. C.,
Commissioner Public Works and Mines.

SIR,—

I beg to enclose a plan of the works at Waverley Gold District, on the Tudor and North leads, during the year 1869.

You will remember that when I commenced my geological survey of the Waverley District, in the autumn of 1868, the works on the Tudor and North leads had been abandoned in the western part of the district, the Tudor lead having "disappeared" close to the boundary line of areas 201 and 202, about eighty feet from the northern limits of those areas.

In the large plan now in your office, of which a reduced lithographic copy accompanied my report on that district, I have indicated by dotted lines the probable outcrop for some thousand feet of the Tudor lead, the North lead, and a large number of other leads symmetrically arranged.

The indicated outcrop of these leads was based upon :

- 1st. The manner in which the leads originated. I described them as auriferous beds of quartz of contemporaneous age with the enclosing rock.
2. The geological structure of the district, which I showed to consist of an east and west anticlinal tilted over to the north, and again, by subsequent movements, tilted to the west; (the north and south anticlinal). During the latter movements I stated that the strata had been dislocated, squeezed, and subsequently denuded. The position and approximate extent in feet of the main dislocations, are represented in detail on the plans referred to.

The theoretical outcrop assigned to the leads at Waverley was the result of the study and delineation of this complicated structural arrangement. I now beg to call your attention to the degree to which theoretical deductions have been borne

out by practical workings and discoveries during the past year.

The enclosed plan has been kindly furnished by Mr. B. C. Wilson, machinist and mining engineer, who has been extensively occupied at Waverley during the past season.

Operations for the search of the "South Tudor" commenced late in the fall of 1868, near the road marked on the plan, 770 feet from the point where the lead was lost. At the date of Mr. Wilson's letter it had been traced backwards to area 201, through a distance of eleven hundred feet.

The mean difference between the ascertained outcrop of the lead and the theoretical outcrop, given on the plan in your office, is 25 feet 9 inches over a distance of 1109 feet. When both theoretical and actual outcrops are reduced to the same level, the mean difference is considerably less.

The mean difference between the theoretical and actual outcrops of the North lead, over a space of nine hundred feet, is 25 feet 7 inches.

The rocks throughout these distances of 1100 and 900 feet are deeply covered with boulder drift, and of uneven surface, so that I may reasonably claim a much closer approximation between theory and fact than a mean difference in outcrop of 25 feet 8 inches over a space of two thousand feet.

The accompanying plan is a copy of a portion of the plan in your office. The black dotted lines represent the probable outcrop I assigned to the leads in October, 1868. The red lines show, according to Mr. Wilson's survey, the actual outcrop discovered up to January, 1870. Enclosed is a copy of Mr. Wilson's letter.

I have the honor to be,

Your obedient servant,

HENRY Y. HIND.

*Waverley Gold Fields,
8th January, 1870.*

HENRY Y. HIND, Esq.

DEAR SIR,—

In reply to your favor of 27th December, I beg to say that I have examined the formation as developed in Mr. Burkner's workings on the south dip, and around the curve of what is unquestionably the Tudor lode, and accompanying please

find a plan which will illustrate the course with the openings thereon.

The developments so far determine—

1st. That the lodes have been traced around the curve of the anticlinal axis, proving indisputably the continuation of the Tudor and other veins, from their east and west course, with a northern dip, around in the form of a parabolic curve to a corresponding (east and west) course with a southern dip.

2nd. That the sweep of the curve is much sharper on the northern than on the southern side of the axis.

3rd. That the thickness of the veins and character of the ore in the northern and southern dips are comparatively identical.

4th. That on the south side the lode dips at an angle of about 45 degrees, and near the axis at about 40 degrees.

5th. That the gold streak is from east to west on the south side of the axis, following round the curve till it is from west to east on the northern side.

6th. That on the south side of the anticlinal the Tudor lode grows perceptibly richer and thinner as it goes east, but increases in richness in depth.

7th. That the *North* lode on the southern side is 82 feet from the Tudor, and at 150 feet further comes the *South* lode, so called.

8th. That there is a fault or displacement about 90 feet north of the axis, the movement apparently having been from east to west, the Tudor lode being completely cut asunder, and the two ends shoved past each other about ten feet; the texture of the intervening rock being completely destroyed.

9th. That the "South" lode (on the eastern side of the axis) 18 inches thick, has two partings in it, forming three distinct veins in one; that the character of the ore is identical with the three lodes (in one belt) lying some 90 feet north of the North lode, on the northern dip; the only difference being that there the veins are separated by some two feet of slates, which on the southern side is represented by a mere seam only.

I am, your obedient servant,

B. C. WILSON.

Statement of Quartz raised and Gold obtained from Sherbrooke Gold District for the quarter ending December 31st, 1869.

No. of Lease.	From Area No.	QUARTZ CRUSHED.		GOLD PRODUCE.			
		Tons.	Cents.	Oz.	Dwts.	Gr.	
Ls. 207.	{	640 to 643, 671 to 673, block 3	7	8	3	13	12
Ls. 290, 353, 354.		714, 715, 745, 748, and 777, 778 to 780, block 3	1102	..	334	15	..
Ls. 197.		786, 809, 811, 840, 843, 874, block 3	110	10	36	9	11
Ls. 404.		559, 574, 589, 604, 611, 617, 618, block 3	44	4	44	..	..
Ls. 176.		644, 646, 674, 676, block 3	113	18	158	11	..
Ls. 270, tacked.		711 to 713, 742, 744, 802, 803, &c., block 3	346	..	204	06	..
{		795, 798, 827, 830, 858, 690, 691, 719, 722, 751, 753, block 3. 721, 726, 752, 757, 784, 788, 813, 818, 661, 691, 692, block 4	197	..	129	12	12
		647, 649, 677, 679, block 3	7	10	10	17	3
		534, 540, 584, 586, block 77	48	6	43	10	14
		Ls. 348.	601, 606, 633, 636, 631, 632, 662, 665, 693, 695, block 4	45	..	12	15	4
Ls. 387.	{	653, 655, 683, 685, block 3	18	..	14	..	
Ls. 343, 358, 390.		434, 435, 447, 449, 484, 499, 541, 543, 530, 575, 580, 625, 630, 587, 589	117	..	28	13	23
Ls. 316.							
Ls. 391, 392, 393.							

us. 391, 392, 393.			
	{	630, 587, 589.....	117 ..
		630, 587, 589, 588, 584, 583, 580, 578, 580, 623, {	28 13 22

Statement of Quartz raised and Gold obtained from Sherbrooke Gold District for the quarter ending March 31st, 1870.

No. of Lease.	From Area No.	QUARTZ CRUSHED.		GOLD PRODUCE.				
		Tons.	Cwis.	Oz.	Dwt.	Gr.		
Lease-207.		16	10	25	12	23		
Lease-206, 353, 354.	640, 643, 671, 673, block 3	926	..	352	3	..		
Lease-197.	714, 715, 745, 746, and 777, 778, 780, block 3	15	..	4	10	20		
Lease-100, 176, 404.	776, 809, 811, 840, 843, 874, block 3	409	14	436	11	6		
Lease-181, 362, 405, 423.	644, 646, 674, 676, 668, 670, 637, 639, block 3	916	18	692	8	12		
Lease-270, tacked.	574, 589, 604, 611, 617, 618, block 3	221	16	134	10	..		
	680, 682, 650, 652, 614, 615, 619, 621, 622, block 3							
	711, 713, 742, 744, 802, 805, 831, 836, 859, 864, 887, }							
	889, 714, 748, block 3							